US ARMY AND MARINE CORPS MRAPS

Mine Resistant Ambush Protected Vehicles

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NEW VANGUARD 206

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US ARMY AND MARINE CORPS MRAPS

Mine Resistant Ambush Protected Vehicles

INTRODUCTION

The Mine Resistant Ambush Protected Vehicle (MRAP) is the newest land warfare system in the United States Army and Marine Corps inventory. Designed to meet the challenges of operating in a counterinsurgency environment, the MRAP has taken survivability to a new level. Unlike other vehicles in the US inventory, the MRAP does not have a common vehicle design. There are several vendors, each with their own unique platform. BAE Systems, Navistar International, Force Protection Inc, Oshkosh, and other defense/automotive companies have produced MRAPs for the US Military. Each of these companies manufactured the MRAP according to one of three classifications set by US Department of Defense (DOD): Category I, Category II, and Category III.

The Category I vehicles are the smallest and lightest of the MRAP family. They are officially referred to as the Mine Resistant Utility Vehicle (MRUV) variant and are designed primarily for urban operations. Category II covers the MRAPs designed for convoy security, medical evacuation, and explosive ordnance disposal. The Category III MRAP (whose only example is the Buffalo MRV) performs the same function as Category II but is designed to carry more personnel.

Since their introduction in 2005–07, MRAPs have performed remarkably well in the asymmetric warfare environment. Their unique design and survivability characteristics have saved hundreds of lives, which otherwise would have been lost to landmines or IED attacks. Although manufactured by different companies, nearly all MRAPs have the same features: they are equipped with a V-shaped hull to deflect the blast from an explosive away from the vehicle and also have a higher ground clearance to dissipate the impact from any mine blast.

Although the Americans did not field the MRAP until the latter years of the Iraq War, the vehicle itself was nothing new. Years earlier, the South Africans had pioneered the MRAP during the Rhodesian Bush War (1972–80) and the South African Border War (1966–89). Under the banner of the Ofilant Manufacturing Company (which has been owned, at various times, by Reunert, Vickers, Alvis, and currently by BAE) the South African military created the first line of "mine resistant" vehicles. These models included the Okapi, Mamba, and Casspir MRV – some of which became the basis for American MRAP designs.

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HISTORY AND DEVELOPMENT

An M1114 Up-Armored High Mobility Multipurpose Wheeled Vehicle (HMMWV), or Humvee. In the early years of the Iraq War, the US Department of Defense fielded several thousand up-armored Humvees to counter the emerging Improvise Explosive Device (IED). (US Department of Defense)

By June 2003, three months after the US-led invasion of Iraq, the Improvised Explosive Device (IED) emerged as the enemy's "weapon of choice." By December of that year, the IED was responsible for over half of all US combat deaths and it was soon declared the "number one threat" to Coalition Forces.

The appearance of the IED caught US policymakers and DOD officials by surprise. In the opening days of the Iraq War, many anticipated that the operation would be an easy victory and that American troops would return home within the year. According to Christopher J. Lamb, Matthew J. Schmidt, and Berit G. Fitzsimmons in their book, *MRAPs, Irregular Warfare, and Pentagon Reform*, "this predisposition meant that post-conflict reconstruction and stabilization operations received little attention, as did the possibility of extended civil disturbances or sustained irregular warfare. As a result, US forces trained for high-intensity warfare suddenly confronted problems with which they had no previous experience." In fact, the US military had not trained for irregular warfare or counterinsurgency operations since the Vietnam War. Furthermore, there was no vehicle platform suited for the complexities of the counterinsurgency environment.

As IED attacks were on the rise, field commanders and DOD officials realized that the problem required a multifaceted solution. The most obvious answer was to field a better-armored vehicle but none were readily available. The US Army and Marine Corps had a sizeable fleet of M1 Abrams tanks, but the senior leaders of either service were reluctant to commit their tanks en masse to the counterinsurgency fight. Indeed, during the early days of the

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General Purpose Vehicles LLC entered the MRAP competition with a vehicle known as the Sergeant 4x4. The Sergeant was powered by a Caterpillar C7 turbo engine and built on a Ford F-750 chassis. (Carl Schulze)

IED menace, the most immediate option was the up-armored Humvee. However, by the time US forces invaded Iraq, only 2 percent of the Army's 110,000 Humvees were armored. To make matters worse, the Pentagon had paid so little attention to the whereabouts of their up-armored Humvees that they had difficulty locating all of them. As it turned out, the up-armored variants had been scattered across various installations with no rhyme or reason to their placement. Seventy of these Humvees were, in fact, found at a missile base in North Dakota.

Yet even as the military scoured its bases for up-armored Humvees, it was clear that there were not enough on hand to meet the operational requirements in Iraq. In response, the Army began working with manufacturers to increase production of the up-armored Humvee to replace the soft-skinned versions. Under these circumstances, production of the up-armored variant increased from 51 units per month in August 2003 to 400 vehicles per month in September 2004 – and finally to 550 vehicles per month by the end of 2005. Almost simultaneously, the Army approved the emergency shipping of thousands of "add-on" armor kits for the existing fleet of Humvees already in theater.

Another solution found during the first year of the Iraq War was to rush further M1117 Armored Security Vehicles (ASVs) to Iraq. A Military Police vehicle, the ASV was in danger of being terminated from the 2004 defense budget until Congress saved the program. Although the ASV was significantly lighter and less armored than the MRAPs that were eventually fielded, the ASV offered similar "protection against mines and other ambushes." Early on, commanders in the field recognized the ASV's utility in protecting their convoys and patrols.

Despite these developments, however, the IED threat continued to grow. The first IEDs were little more than simple explosives that the enemy would throw under moving vehicles. Nevertheless, they soon evolved into roadside bombs that could be remotely detonated by a cell phone or a garage door opener. As the up-armored Humvee began to pour into theater, insurgents began targeting the soft underbellies. They were soon burying IEDs in the road and packing them with as many as 100lbs of explosives. Another form of IED, and perhaps the most deadly, was the Explosively Formed Penetrator (EFP), which was able to "better penetrate armor, and in doing so, spray elements of the weapons and the vehicle armor into the vehicle's interior."

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Although they were intended to mitigate the IED threat, the up-armored Humvees, add-on kits, and ASVs were not the best solution. The deliverance of all three was beset by monetary and logistical problems. By fall 2004, the US Army had slightly more than half of its quota for the up-armored Humvee. Even worse, the weight of the add-on kits made the original Humvees difficult to maneuver and ruined their suspensions. As other units waited to receive their add-on kits, they improvised by placing scrap metal, plywood, ballistic glass, and sandbags on their vehicles to increase protection.

By January 2005, it was clear that US troops needed a more heavily armored and specifically tailored vehicle to counter the IED threat. The following month, Marine Brigadier General D. J. Hejlik, deputy commander of the II Marine Expeditionary Force, submitted his Urgent Universal Need Statement to the Pentagon. Within its pages, Hejlik made a forceful case for the MRAP:

> "There is an immediate need for an MRAP vehicle capability to increase survivability and mobility of Marines operating in a hazardous fire area against known threats. The expanded use of IED/RPG and small arms fire (SAF) in the AO [Area of Operations] requires a more robust family of vehicles capable of surviving the IED/RPG/SAF threat as we operate throughout these areas. Marines are expected to respond rapidly, and without a large security contingent, therefore we need a vehicle that allows us to survive the first blow and then counterattack … [Our combined ground forces] are acutely exposed to the IED/RPG/SAF threat as they continue to prosecute offensive operations and security and stability operations.
>
> This need was identified through operational combat experience and critical analysis of casualty data from the Joint Theater Trauma Registry Report (JTTR). JTTR for October [2004] indicates IEDs are number one … mechanisms of injury. MRAP-designed vehicles represent a significant increase in their survivability baseline over existing motor vehicle equipment and will mitigate casualties resulting from IEDs. Operational experience dictates current and anticipated missions in theater are better supported by a family of MRAP vehicles.
>
> The MEF [Marine Expeditionary Force] cannot continue to lose [personnel and equipment] to IED and MVA at current rates when a commercial off-the-shelf capability exists to mitigate [these threats].
>
> The [current fleet of ground vehicles] is constantly exposed to IED/RPG/SFA threats while conducting active combat, combat support, and combat service support as well as the inherent dangers that accrue to vehicles conducting line and long haul missions over the open roads. Operating forces, service components, and supporting establishments have come together to modify and enhance vehicle protection … [The MRAP] would provide the operating forces with a modular and scalable system capable of increasing the level of protection in accordance with the type of weapons available to the enemy.
>
> The MRAP will mitigate or eliminate the three primary kill mechanisms of mines and IEDs – fragmentation, blast overpressure, and acceleration. It will also counter the secondary kill mechanisms of vehicle crashes following mine strikes and fire aboard vehicles. The MRAP vehicle capability will help establish a baseline survivability index that will increase protection and reduce the number of casualties requiring … medical treatment in a given theater of operations."

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Before its success with the M-ATV, Oshkosh entered the MRAP competition with the Thales Bushmaster. Although it was not selected under the MRAP program, the Bushmaster is in active service with the Dutch and Australian armed forces. (Carl Schulze)

General Hejlik went on to say that the proposed family of MRAP vehicles should include a multi-role utility platform (i.e. gun truck), an ambulance variant, a "command and control" vehicle, a troop transport, a cargo hauler, and an upgraded version of the existing Buffalo Mine Removal Vehicles.

In the same Universal Urgent Need Statement, Hejlik forecasted that the vehicle would need a monocoque hull (meaning that the body and chassis would form a single unit, thereby eliminating the need of an internal frame or truss). He then outlined 14 critical requirements that the MRAP would need to be effective in combat:

- The MRAP had to withstand a blast from at least 30lbs of explosive underneath a wheel and at least 15lbs underneath the exposed hull.
- The outer skin had to protect the crew from 7.62mm gunfire at a range of at least 30m. This requirement was based on the studied patterns of Iraqi insurgents' small arms tactics.
- Protection from overhead airbursts or side blasts from 155mm shell. In the early days of the IED threat, the insurgents had become quite adept at rigging 155mm artillery rounds to command detonators.
- Ideally, the MRAP would also have the capability to protect the crew from gas agents or other biological/radiological weaponry.
- Rifle firing ports to allow passenger riflemen to engage the enemy.
- The MRAP had to accommodate a remote firing system from the gunner's station.
- Easily repairable and equipped with modular parts that could facilitate a "plug-and-play" maintenance and service plan.
- A high-grade safety harness for each crew member seat. Hejlik recommended harnesses based on the models found in the UH-60 family of helicopters (i.e. Blackhawk, Seahawk, etc.), featuring an ergonomic design and a quick release function.
- The seat cushions would also have to be of an aircraft quality. Crew seating had to be shock absorbent, "multi-positional with emphasis on ability to fight effectively (outward field of vision to facilitate rapid weapons employment)," and be fully removable based on mission requirements.
- Rated to withstand a 360° rollover with no significant damage to the vehicle's structure or on-board instrumentation.
- Be equipped with air conditioning and heat control.
- Have the ability to receive scalable, "add-on" armor for enhanced protection.
- Adequate cargo space and anchored storage boxes to minimize the risk of "secondary projectiles," which would come from the upward force of a mine attack or the centrifugal force of a rollover.
- Have an on-board fire suppression system in the cab and crew compartments.

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Finally, after authorization from the US Secretary of Defense (SECDEF) and the Pentagon's Joint Requirements Oversight Council (JROC – the organization responsible for validating the military's requirements), the Mine Resistant Ambush Protected vehicle program went forward. But even before the MRAP program won approval from the SECDEF and JROC, American ground forces had procured a small number of existing MRAPs as early as fall of 2003. These limited quantities (coming mostly from South African channels) trickled into theater over the next four years and began arriving en masse once Congress and the American defense establishment sanctioned the MRAP program.

The Cheetah, built by Force Protection Inc, was an early contender for the MRAP All-Terrain Vehicle (M-ATV) program, but was ultimately rejected in favor of the design submitted by Oshkosh Defense. Force Protection later submitted the Cheetah for consideration under the Joint Light Tactical Vehicle (JLTV) program, but it was ultimately dropped from the competition. The Cheetah was the smallest of the Force Protection line-up. Although 13 prototypes were built, it was never adopted by any nation's military. (Carl Schulze)

Early in the MRAP's development, defense planners determined that there had to be different categories of MRAPs to handle different missions. Category I MRAPs were the smallest and lightest of the family – designed for rapid speed, maneuverability, and protracted urban combat. Described as "fire team-size vehicles," they were capable of holding up to six occupants, including the driver, gunner, and vehicle commander. Their primary purpose was to serve as armored personnel carriers or gun trucks employing medium- or heavy-caliber machine guns. Category I MRAPs could also be used by reconnaissance units for long-range surveillance and target acquisition.

Every MRAP had to provide crew protection and mobile firepower, but some variants had to be modified for missions that fell beyond the realm of direct enemy engagement. Combat medics, sappers, and bomb squads needed a platform suitable for their mission sets – hence, the concept for the Category II MRAP was born.

The US Army described the archetypal Category II MRAP as a "squad-sized" vehicle capable of holding up to ten occupants, including the driver, gunner, and vehicle commander. Category II MRAPs were arguably the most versatile of the family. This multi-mission vehicle filled the roles of convoy security, medical evacuation, explosive ordnance disposal, battlefield command post, combat engineering, cargo transport, protected personnel transport, and traffic control operations. During their service in the Iraq War, Category II MRAPs were often used by rifle and sapper squads as Quick Reaction Force vehicles.

On July 31, 2007, Marine Corps Systems Command began a pre-solicitation to MRAP vendors for a Category II prototype. Over the ensuing year, several Category II MRAPs made their debut in the War on Terror. These included BAE's RG-33L and Caiman 6x6, Force Protection Inc's Cougar 6x6, Navistar International's MaxxPro XL variant, and the BAE-General Dynamics jointly produced RG-31E.

Finally, Category III MRAPs were devised for mine detection and roadside bomb removal. However, the only MRAP procured under Category III was

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The International MXT was another contender for the MRAP program. The MXT was a militarized version of International's Extreme Truck. Although the vehicle was not procured by the US Military, the MXT is currently in service with the British Army, where it is known as the Husky Tactical Support Vehicle (Medium). (Carl Schulze)

the Buffalo Mine Removal Vehicle, which was already in service with frontline units at the start of the MRAP program.

Because the MRAPs had to fill various roles – and had to be delivered quickly – the Pentagon decided not to rely on only one vendor. The first contenders for the MRAP program were BAE Systems, Force Protection Inc, General Dynamics Land Systems, General Purpose Vehicles (GPV), Navistar International Military Group, Oshkosh Truck, Protected Vehicles Inc (PVI), Textron Marine and Land Systems, Rafael Advanced Defense Systems, Land Systems OMC (the South African component of BAE), and Armor Holdings (later bought out by BAE in July 2007). The call for an MRAP vehicle brought several companies to the drawing board. Some, like BAE and Textron, were already powerhouses in the defense industry. Others, like GPV and Protected Vehicles Inc (known for their construction vehicles and armored trucks) sought to make their debut in the coterie of defense contractors. Rafael Advanced Defense Systems and Land Systems OMC were among the few foreign companies submitting bids for the MRAP.

Rafael, one of Israel's premier defense contractors, had been producing arms for the Israeli Defense Forces since the 1950s. Their design for the MRAP competition was the experimental Golan Armored Vehicle. A 4x4 chassis weighing 15 tons, the Golan could accommodate ten soldiers and protect the crew from land mines weighing up to 14kg. The V-shaped hull was a monocoque configuration; this enabled Rafael to dedicate nearly 50 percent of the vehicle's weight to armor protection. This, in turn, allowed the Golan to be fitted with add-on armor slats. The slats' highest level of protection included a reactive armor that proved remarkably effective in early tests against EFP mines and IEDs. The Marine Corps ordered some 60 units of the Golan, but quickly discontinued them from service. Rafael was then dropped from the MRAP competition.

BAE's Land Systems OMC entered the game with recycled versions of the same line-up they had fielded to the South African Army for years. Leading the OMC line-up was the RG-31 Nyala, a new design based on the company's successful Mamba APC. The Mamba – a 4x4, 12-crew, mine-resistant vehicle – was built on a German Unimog chassis and powered by a Mercedes Benz 352N diesel engine. It had been in service with the South African Army since 1995 and had become the "vehicle of choice" within several UN peacekeeping forces. For the RG-31 variant, Land Systems OMC improved the vehicle's suspension and ballistic rating, and introduced an all-steel, V-shaped, monocoque hull.

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After OMC won a series of contracts to produce the RG-31 for American ground forces, the company introduced the RG-33 – similar in appearance to the RG-31 but nearly twice the size. Looking beyond the market for Category I MRAPs, Land Systems unveiled a 6x6 variant, the RG-33L, for Category II.

Meanwhile, Navistar International unveiled their MaxxPro variant. It was among the largest of the initial MRAP designs, especially for a 4x4. During their first year of producing MRAPs, Navistar International created MaxxPros for both Category I and Category II specifications. The Category II design, known simply as the MaxxPro XL, carried many of the same features as the Category I MaxxPro but had a higher-performing engine and an increased payload capacity. In May 2007, Marine Corps Systems Command ordered 1,200 MaxxPros at the cost of $623 million. This was soon followed by another order for 16 MaxxPro XLs in June 2007. That same month, the US Army ordered an additional 755 Category I MaxxPros.

MaxxPros being assembled at the Navistar International plant in 2007. Navistar was the largest vendor of MRAPs to the US Military, with over 5,000 units delivered. (Navistar International)

Per the Army's request, Textron happily filled more orders for their M1117 ASV. The Marines, however, were not as impressed with the M1117 and removed Textron from their list of contractors. Oshkosh developed a Category I prototype known as the MRAP Alpha. Marine Corps Systems Command placed an order for 100 of these vehicles, but eliminated Oshkosh from the competition on June 29, 2007 – stating that they had grave concerns "regarding overall vehicle survivability," as well as ergonomic issues and other automotive deficiencies. Oshkosh then tried to develop an MRAP for the Category II bids. In a joint effort with the French company Thales, Oshkosh unveiled the Bushmaster IMV. Initial tests looked promising, but again, the vehicle was dropped from consideration after numerous design flaws were discovered.

In 2009, however, Oshkosh returned to the MRAP program with the MRAP All-Terrain Vehicle (M-ATV). As the United States began to draw down its forces in Iraq and send more troops into Afghanistan, it was clear to US policymakers that their ground troops needed an MRAP that could operate in more than just urban environments. With a smaller frame and a lower center of gravity than any of its predecessors, the M-ATV finally won Oshkosh a spot on the MRAP team.

A MaxxPro Dash on patrol in Iraq. The MaxxPro Dash was developed in response to growing complaints about the base model's susceptibility to rollovers. The Dash was virtually identical to the base model but was lighter, smaller, and had a narrower turning radius. (Jonathan Mallard)

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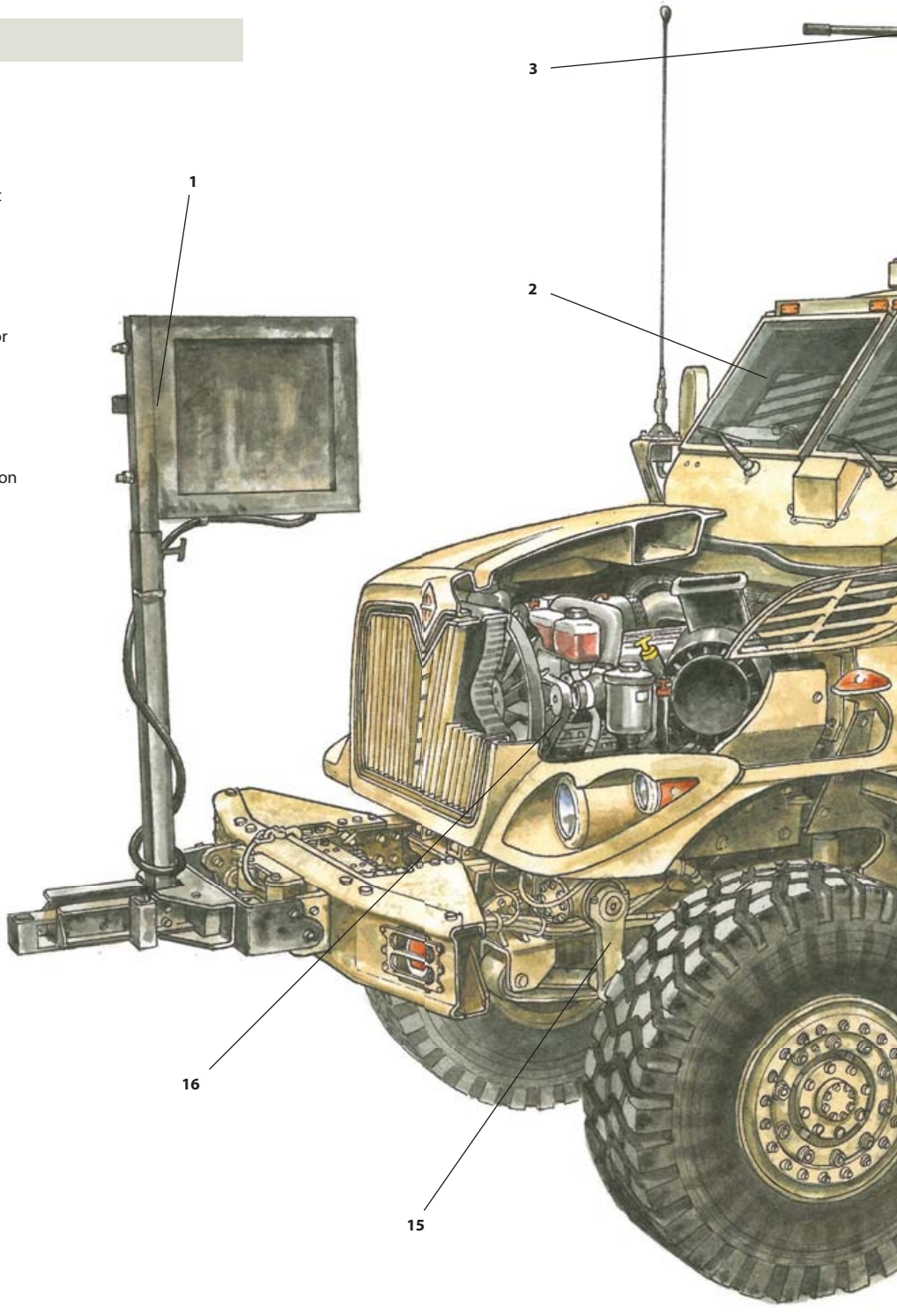
A

MAXXPRO

With over 7,000 units fielded, the MaxxPro has become the flagship of the MRAP program. It leads the Category I class with a 4x4 chassis and V-shaped hull offering 14 inches of ground clearance. The MaxxPro can accommodate a crew of seven – including the driver, vehicle commander, gunner, and four dismounts seated in the rear. After initial testing at Aberdeen Proving Ground, the first MaxxPros arrived in theater in late 2007. Despite the vehicles' protective capabilities, operators have often complained about its high center of gravity, tendency to roll over and its poor performance in off-road handling.

Key

1. IED electronic detection device
2. Bullet- and blast-resistant glass
3. M2 Browning machine gun
4. Tactical floodlight
5. Objective gunner's protection kit
6. GPS/communication antenna
7. Grated window armor
8. General purpose cable aperture
9. Quick-release ramp
10. Plasan-manufactured body armor
11. External storage
12. "Run flat" tires
13. Crew compartment
14. Driver's seat
15. DXM fully independent suspension
16. MaxxForce 9.3D engine



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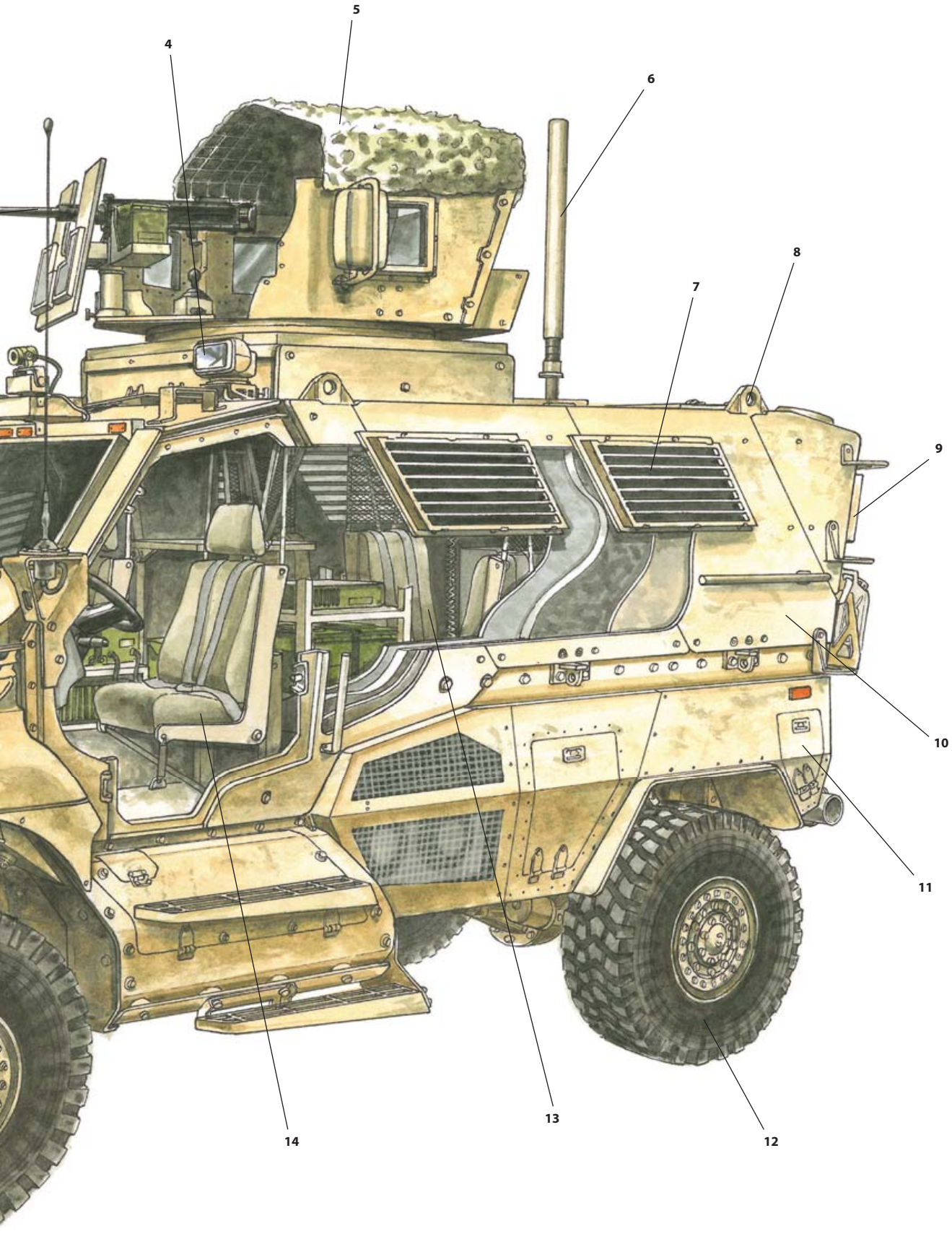

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Soldiers from Bravo Company, 1-30th Infantry Battalion, 2nd Brigade Combat Team, 3rd Infantry Division, test drive a new MaxxPro on the Off-Road Confidence Course at Camp Liberty, Iraq, on November 7, 2007. (US Army)

GPV entered the competition with a model known as the Sergeant 4x4. Based on the Ford F-750 chassis, the Sergeant 4x4 was popular among law enforcement agencies as a SWAT and rescue vehicle. Although driven by a powerful Caterpillar turbo diesel, the Sergeant was eliminated early in the competition. GPV also contested a Category II variant known as the Commander, but it too was dropped from the stakes. PVI produced a number of prototypes during the first year of the MRAP competition – none of which made the final cut. Among the earliest PVI designs was the Bulldog, a Category I entry with a 4x4 chassis. The Bulldog had an eight-crew seating capacity and was designed to "serve the needs of diplomatic, VIP, and other security related agencies in high-risk areas" where traditional vehicles, such as up-armored Chevrolet Suburbans, were no longer adequate to meet the civilians' protective needs. PVI also submitted a design called the Argus (which looked remarkably similar to the MaxxPro) and another prototype known as the Ridgeback (a contender for the Category II program). PVI rounded out its first string of prototypes with the Protector and the Beast. The Protector was designed to counter the deadly nuisance of EFPs while the Beast was a mine-removal vehicle, similar in function to the Buffalo MRV. Sadly, PVI dropped out of the competition amidst financial trouble and closed its doors in December 2007.

Meanwhile, BAE also introduced the Caiman. Available in a Category I 4x4 and a Category II 6x6 configuration, the Caiman would become BAE's signature vehicle. Force Protection Inc entered the fray with the Cougar and Buffalo MRV. Of the two, the Buffalo was the only vehicle that pre-dated the MRAP program and even the War on Terror. The Buffalo was based on the Denel-Mechem Lion II. The Lion II was a South African mine-protected personnel carrier inspired by OMC's Casspir Mk II. In the late 1970s, the South African Council for Scientific and Industrial Research designed the Casspir with the goal of creating a highly maneuverable armored vehicle with passive mine defense technologies. This led researchers to develop the distinctive V-shaped hull mounted atop a wheeled chassis. Debuting in

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A MaxxPro prepares to leave on a combat patrol in Afghanistan, 2009. (US Department of Defense)

1980–81, the Casspir is widely regarded as the world's first mine-resistant vehicle. OMC took over production in the mid-1980s and continued fielding the vehicle into the 2000s. The Buffalo, of course, found its way into the MRAP program as the only Category III vehicle.

The US Army had acquired the Buffalo in 2000 as part of the Ground Standoff Mine Detection System (GSTAMIDS) program. The Buffalo came equipped with a long, robotic arm (operated from inside the vehicle), which could pick up and examine suspicious objects from a distance of about 7 meters. The Cougar, like the Caiman, was offered as a 4x4 and 6x6, respectively designed under Category I and Category II specifications. Inspired by a combination of earlier designs from the British, Rhodesian, and South African forces, the Cougar won a surprising number of orders during the opening months of the MRAP evaluation.

At around the same time, Force Protection also introduced the Cheetah – the smallest vehicle in their line-up and based primarily on BAE's RG-31 design. Although it was ideally suited for urban combat and urban reconnaissance, Force Protection submitted it for consideration under the Joint Light Tactical Vehicle program (a project to find a replacement for the military's aging fleet of Humvees), but it was ultimately rejected. Force Protection resubmitted the Cheetah for the M-ATV competition, but was edged out by the Oshkosh design. Between 2007 and 2008, only 13 prototypes of the Cheetah were built and, to this day, it has not been procured by any nation's military.

Once they arrived in theater, the MRAPs made a significant impact. The first en masse vehicle deliveries took place in the fall of 2007. By the end of that year, JROC had approved the acquisition and fielding of over 15,000 MRAP variants, with full integration expected by the fall of 2009. From these modest beginnings, the number of MRAPs in service grew exponentially from 1,500 in November 2007 to over 10,000 by December 2008 – the largest and most rapid fielding of any combat vehicle since World War II. Although IED attacks were on the decline by the time the platform was fielded, the MRAP

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The first MaxxPros to arrive in Iraq are configured into a motor pool setting at Camp Liberty, Iraq. (US Army)

still saved numerous lives. Statistically, the casualty rate for personnel in MRAPs was less than 6 percent, compared to 22 percent for those in the up-armored Humvee. Then-Brigadier General Lawrence Nicholson, Deputy Commander of the Marine Corps Combat Development Command, said, "I've seen MRAPs … taking hits that no Humvee or no Amtrak would've survived." Other statistics claim that the MRAP was "up to 400 percent more effective than the up-armored Humvee in reducing injuries and deaths."

As with any military vehicle, however, the various MRAPs were not without their limitations. Because of their high ground clearance, the MRAPs had a higher center of gravity, making them more susceptible to rollovers than most other combat vehicles. In fact, experience has shown that MRAPs begin to roll over once they reach a 25° angle. Nearly all MRAPs (with the exception of the M-ATV) have fared poorly when taken off-road. The heavy weight of the Category I and II MRAPs was an issue when crossing bridges or operating on soft soil. They have also been described as delicate vehicles with extremely sensitive handling – very undesirable characteristics for a combat vehicle. Maintenance has also been a persistent problem for the MRAP – mainly because there are several models and nearly all of them are made by different vendors. Much of the MRAP maintenance has been performed by DOD contractors. Because each MRAP requires a different set of technical knowledge and skills to maintain, DOD is still devising a "long-term maintenance strategy" so that an adequate number of military personnel will be able to fill the various maintenance roles.

Despite these drawbacks, however, the MRAP has performed remarkably well in Iraq and Afghanistan and has saved hundreds of American lives from the ominous threat of the IED.

B

OSHKOSH M-ATV

An American M-ATV engages the enemy during a firefight in Afghanistan. Developed by Oshkosh Defense, the M-ATV was fielded in response to a growing number of concerns about the legacy MRAPs' ability to maneuver off-road. Per Department of Defense specifications, the M-ATV had to have a lighter tare weight, lower center of gravity, and narrower turning radius.

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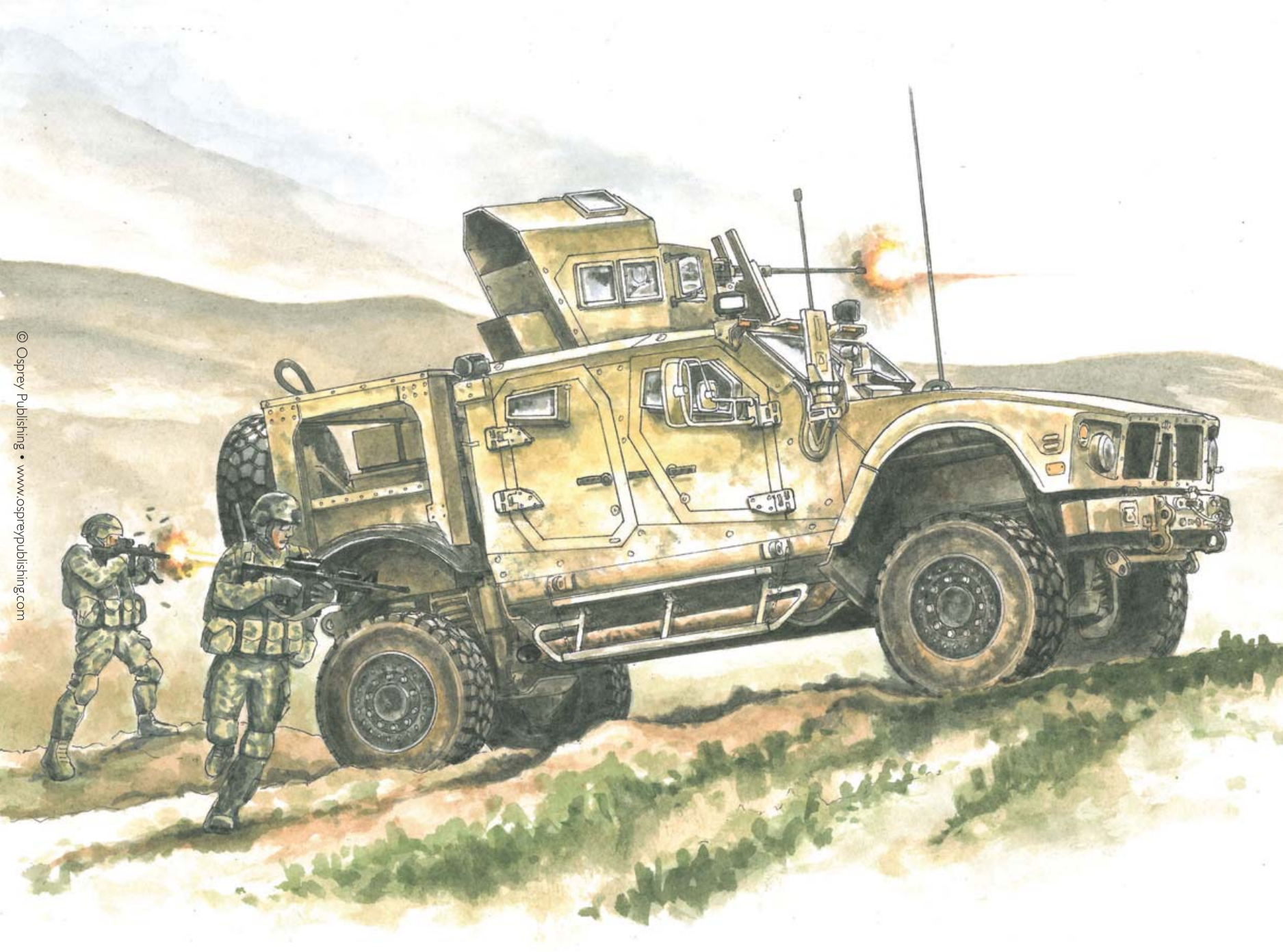

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THE PRE-MRAP: M1117 ARMORED SECURITY VEHICLE (ASV)

During the first year of the Iraq War, the M1117 ASV was the only mine-resistant platform readily available to US forces. Yet, ironically, the ASV program was almost cancelled in 2004. Developed in 1998 by Textron, the ASV was based on the chassis of the V-100 Commando Security Vehicle, which had been used extensively by American forces in Vietnam. The M1117 remained one of the lesser-known vehicles in the US Army until the Iraq War in 2003.

The idea for the ASV was conceived around the same time as the M1126 Stryker vehicle – the centerpiece of "Army Transformation." According to senior military officials, American warfare since the end of the Gulf War had shifted almost exclusively to peacekeeping and contingency-style operations. Thus, "with the changing nature of warfare and the elevation in asymmetric conflicts," Textron proclaimed that a combat vehicle's "survivability, mobility, and deployability are paramount." According to Textron, the ASV "fills the capability gap that existed between larger armored systems and smaller bolt-on armor type of vehicles." This realization fit nicely into the Army's long-term strategic plan to transform itself into a lighter, leaner, and more agile force that could successfully engage the enemy across the spectrum of combat environments.

The ASV was initially developed for implementation into the heavy military police company. Under this configuration, the military police company would have a total of 15 ASVs; three vehicles within each of the four platoons and three vehicles in the company headquarters section. The ASV was fielded to supplement the roles traditionally performed by military police units: mounted protection, convoy escort, route reconnaissance, mobile surveillance, and crowd/riot control. Around this time, Textron also created a variant known as the M1200 Armored Knight, a precision-targeting vehicle for field artillery operations.

An M1117 Armored Security Vehicle (ASV) on patrol in Iraq. A US Military Police vehicle, the ASV was used extensively for convoy security and route reconnaissance. In the early days of the Iraq War, the ASV was the only readily available mine resistant vehicle that US forces had. With its V-shaped hull and improved armor, the ASV carried many of the features that became standard on the MRAP. (US Army)

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Beginning in 1998–99, a total of 94 ASVs were slated for production under Textron's $149.5 million contract. Despite this projection, however, only 53 ASVs had been delivered by 2003. The first unit to receive them was the 708th Military Police Battalion (part of the US Army's V Corps in Europe), which field-tested the vehicle extensively throughout Kosovo. The ASV was outfitted with an expandable armor package consisting of ceramic-based appliqués and an enclosed turret equipped with a Mk 19 grenade launcher and a .50 caliber machine gun. It also carried many of the same features that later became standard on the MRAP variants, including angled armor and the V-shaped hull.

When the Iraq War began in 2003, the military police units equipped with the ASV were better prepared to meet the deadly challenges of the IED. Granted, not all ASVs withstood their encounters with roadside bombs, but the crew survivability rates were much higher compared to other units equipped with standard or up-armored Humvees. On one occasion, an ASV survived an IED attack and returned 28 miles (45km) to its base camp, notwithstanding that all four tires had been blown out. The ASV could also survive a direct hit from an RPG, but the survival of the crew depended largely upon where the projectile hit.

Witnessing the success of the vehicle in combat, the Army removed its cancellation flag from the ASV program and ordered several more units of the vehicle. With its newfound funding, production of the ASV rose from one vehicle every three weeks to over 56 units per month. Production remained steady until the fall of 2005, when Textron's production facility – located in New Orleans – was badly damaged by Hurricane Katrina. The factory, nonetheless, was quickly repaired and full production resumed by November 2006. By the following year, over 1,700 ASVs were either in service or slated for production. Many of the vehicles had by then been fielded to other Army ground units or given to the Iraqi National Police.

When discussion of the MRAP program began, some politicians preferred using the ASV rather than developing a new set of vehicles. Thus, the ASV was also an early contender in the MRAP evaluation. However, after it failed the initial ballistics test at Aberdeen Proving Ground, Maryland, the Marine Corps decided not to purchase the vehicle. Specifically, Marine representatives were concerned about the vehicle's weight-to-protection ratio. As with any military vehicle, there is often a trade-off between protection and mobility. The ASV was significantly lighter than the other MRAP entries and, although it performed well against many mine and ambush scenarios, evaluators did not think it fared as well against 30–50lb (13.5–23kg) explosives. Although the Army did not

An M1117 ASV on training maneuvers at the National Training Center in Fort Irwin, California. The ASV was an early contender for the Category I MRAP in 2007 before testers decided against it. (Jarek Tuszynski)

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incorporate the M1117 into its MRAP program either, they nonetheless ordered more ASVs for their military police units and convoy escort teams. In fact, from December 2006 until October 2007, the Army awarded over $54 million dollars in contracts to Textron to produce nearly 200 ASVs until the end of that decade.

Interestingly, the ASV's concept and design foreshadowed the requirements needed to produce an effective MRAP vehicle for the US military. And although the ASV was never accepted into the MRAP program, it was the first non-tracked US vehicle to display any effective resistance against the IED threat. Its enclosed turret (which gave the gunner adequate time to reload his weapon while in contact with the enemy), "coupled with M36 E3 day/night sight and 360° vision blocks," gave American forces a decided advantage on the non-linear battlefield during the early days of the Iraq War.

Specifications – M1117 ASV	
Operators	USA, Bulgaria, Colombia, Iraq, Romania
Chassis Configuration	4x4
Length	237in.
Width	101in.
Height	102in.
Minimum Ground Clearance	18in.
Maximum Speed	65mph
Standard Weight	29,260lbs

NAVISTAR INTERNATIONAL MAXXPRO

By far the most widely used MRAP is the International MaxxPro. Navistar International built MaxxPro variants for Category I and II (MaxxPro XL), although the majority of those fielded have been Category I models. The MaxxPro features a reinforced crew compartment with a V-shaped hull mounted onto an International Workstar 7000 chassis. With a composite armor shell developed by the Israeli Plasan company, the MaxxPro's armor was bolted together instead of welded. This facilitated quicker maintenance, exchange of parts, and the ability for Navistar to rapidly manufacture and field more vehicles.

A MaxxPro Plus seen on display at a trade show in the UK. The MaxxPro Plus featured a stronger engine and a higher payload capacity than the base model. The Plus also included an upgraded armor kit to help defeat the Explosively Formed Penetrator variety of IED. To accommodate the additional weight, the Plus sported dual wheels on its rear axle. (Author's Collection)

When International first entered the competition, it submitted only two prototypes for the initial round of testing at Aberdeen Proving Ground, Maryland, in March 2007. Following this test, which included maneuver drills and explosives tolerance, Marine Corps Systems Command placed their first order for 1,200 of the Category I vehicle. Although the MaxxPro was larger than any other combat vehicle then in theater, the Pentagon appreciated its speed and survivability. By the end of 2007, the US Military had ordered a total of 4,471 MaxxPros.

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After the initial success of its Category I model, Navistar International decided to push a Category II variant known simply as the MaxxPro XL. For making the leap to Category II, the XL differs only slightly from its Category I counterpart. The XL model carries a gross vehicle weight of up to 52,000lbs and has dual wheels at the rear to accommodate the additional tonnage. It also comes equipped with a 375 horsepower MaxxForce 10 engine instead of the 330 horsepower DT350 used in the base model Category I variant. Aside from these upgrades the XL is virtually identical to the Category I.

A MaxxPro XL. The XL variant was elongated and had more stowage capacity than the base model. It could be easily configured for ambulance, command and control, or explosive ordnance disposal. (Navistar International)

Throughout 2008, the MaxxPro was one of the few Category I MRAPs still receiving fresh orders to frontline units.

The MaxxPro's popularity continued to grow and, in September 2008, the Marine Corps awarded a $752 million contract (the most expensive contract awarded for an MRAP at the time) to Navistar International for a lighter and more mobile version of the MaxxPro. The result was the MaxxPro Dash. The Dash variant essentially took everything from the base model and scaled it down to mitigate the rollover hazard. It introduced a lower center of gravity, lower torque-to-weight ratio, and a smaller turning radius.

Since its first deliveries in 2007, there have been over 7,000 MaxxPro variants built, most of which have served in the Iraq War. In many ways, the MaxxPro has become the flagship of the MRAP program, featuring prominently in American news stories surrounding the "troop surge" and the drop in violence and IED attacks.

A convoy of MaxxPros belonging to the 2nd Brigade Combat Team, 1st Infantry Division, prepares to depart Iraq after nearly a yearlong deployment from 2010–11. (Brent Holman)

Specifications – MaxxPro	
Operators	USA, Croatia, Estonia, Greece, Hungary, Poland, Romania, Singapore, South Korea
Chassis Configuration	4x4
Length	250in.
Width	120in.
Height	159in.
Minimum Ground Clearance	10.9in.
Maximum Speed	69.2mph
Standard Weight	43,500lbs

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The MRAP All-Terrain Vehicle, or M-ATV, was developed by Oshkosh Defense and fielded to American forces in Afghanistan throughout 2009. This M-ATV features the M153 Common Remotely Operated Weapon System, or CROWS, mounted with an M240B machine gun. (US Army)

OSHKOSH DEFENSE M-ATV

Although the M-ATV was never "officially" classified into an MRAP category, its size and technical specifications warrant the vehicle's inclusion in Category I. As the US began to send more of its ground forces into Afghanistan, it became increasingly clear that the existing fleet of MRAPs were unsuitable for off-road maneuvers or sustained operations in rough terrain. The complaints being registered about the Category I and II vehicles were nearly unanimous: they handled poorly, they couldn't go off-road, and they were too top-heavy. The MRAP program managers then issued a Joint Urgent Operational Needs Statement calling for a lighter, leaner, and more agile MRAP that could perform off-road missions. On March 11, 2009, Pentagon Press Secretary Geoff Morrell said at a press conference that the M-ATV would be an operational stepping stone to the Joint Light Tactical Vehicle (JLTV) – a four-wheeled combat vehicle that would combine the agility of the Humvee with the protective capacity of the MRAP.

According to defense planners, the MRAP All Terrain Vehicle needed to have a gross weight of no more than 25,000lbs (11,350kg) and a tare weight of no more than 17,000lbs (7,718kg). It also needed to accommodate a crew of five, including a gunner and driver. Smaller vehicle dimensions and a narrow turning radius were also critical. Per earlier MRAP requirements, the M-ATV had to protect the crew from the most intense mine blasts and Explosive Formed Penetrator IEDs. The first proposals were submitted to manufacturers on January 12, 2009. Six designs then came forward for the initial testing phase: a Caiman 4x4 variant known as the Caiman MTV, two BAE M-ATV prototypes, the Oshkosh M-ATV, the International MXT, and the Cheetah from Force Protection Inc.

An M-ATV negotiates rough terrain on a driver's course. (US Army)

BAE entered the fray in February 2009 with two M-ATV variants, which they submitted for two months of extensive trials. Shortly thereafter, Force Protection Inc won a contract to deliver two Cheetah prototypes.

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"The Cheetah vehicle, which had been in development since late 2005 … passed testing to MRAP I survivability levels and had undergone initial mobility and durability testing at the US Army's Nevada Automotive Test Center." International's MXT was first developed in 2006 and marketed as an armored utility truck deliverable by C-130. The MXT M-ATV variant was screened out of the competition early, but the British Army ordered several hundred of the vehicle and rebranded it as the Husky Tactical Support Vehicle (Medium). This version of the MXT remains in service with the British Army to this day. Though Oshkosh Defense was comparatively late in submitting their M-ATV, it won the contract after extensive trails. On June 30, 2009, the US Army ordered 2,244 M-ATVs, with the first deliveries made in October 2009.

Soldiers from the 1-35 Armor Battalion, 2nd Brigade Combat Team, 1st Armored Division, perform a casualty evacuation exercise with their M-ATV near Fort Bliss, Texas in the spring of 2011. The 1-35 Armor is equipped exclusively with MRAPs and utilizes a large number of M-ATVs. (US Army)

The Oshkosh M-ATV was assembled on the Medium Tactical Vehicle Replacement (MTVR) chassis. The MTVR was an earlier Oshkosh design sold to the US Navy and Marine Corps as a replacement for the M939 utility trucks. Fielded in 1998, the MTVR had a significant improvement in off-road maneuvering as it could carry a 7-ton payload across virtually any unimproved surface. With its proven excellence in off-road handling, Oshkosh knew they had found the basis for the all-terrain MRAP. Covering the chassis was a unique armored hull designed by the Israeli manufacturer Plasan. The underbelly of the vehicle came equipped with a new TAK-4 independent suspension, traction control, and anti-lock brakes controlling four heavy-duty run-flat tires. Like its urban-focused predecessors, the M-ATV could accommodate a variety of weapons from atop its turret. These included an M240 machine gun, an M2 Browning .50 caliber machine gun, a Mk 19 grenade launcher, or a TOW missile system.

Soldiers from Alpha Company, 2-18th Infantry Battalion, 170th Infantry Brigade Combat Team assist the Afghan National Policemen at a checkpoint in Pul-E Khumri, Afghanistan – March 18, 2011. (US Army)

Arriving in Afghanistan, the M-ATV dramatically increased the survivability and mobile combat power of the American ground units. For instance, on the night of March 28, 2010, elements of B Company, 2nd Battalion, 503rd Infantry (173rd Airborne Brigade) were on patrol in their new M-ATVs in the Kunar River Valley of Afghanistan. As the patrol funneled into a narrow passageway between two mountains, it was suddenly attacked from both sides by

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A US Marine Corps M-ATV from Lima Company, 3rd Battalion, 5th Marines, leads a convoy of vehicles through the Sangin Valley of Afghanistan. The 3rd Battalion was assigned to conduct counterinsurgency operations as part of the International Security Assistance Force (ISAF). (US Marine Corps)

A US Army M-ATV leads a resupply convoy during Operation *Helmand Spider* in Badula Qulp of the Helmand Province of Afghanistan. The device attached to the grille of the vehicle is a counter-IED device, designed to jam the signal sent to any remotely controlled electronic IED. (US Army)

Taliban RPG teams. At the outset of the engagement, the Taliban fighters hit the M-ATV with three consecutive RPG rounds, all of which made little more than a dent in the side of the new MRAP.

Although the vehicle has quantitatively saved lives in Afghanistan, the M-ATV has also had its fair share of criticism. Soldiers have stated that, despite its comparative ease in off-road handling, it is still top-heavy, cramped, and prone to both engine and mechanical problems. Taken together, these problems represent challenges that have plagued the MRAP program since its inception in 2007. While these criticisms are valid, the M-ATV, like its predecessors in the Iraqi theater, has done its job to provide better protection from the evolving and creative threats of the counterinsurgency environment.

Specifications – M-ATV	
Operators	USA
Chassis Configuration	4x4
Length	246.8in.
Width	98.1in.
Height	105in.
Minimum Ground Clearance	16in.
Maximum Speed	65mph
Standard Weight	27,500lbs

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BAE CAIMAN 4X4 AND 6X6

Leading the BAE family of vehicles was the Caiman. Sporting the same V-shaped hull as its counterparts, the Caiman was based on the Family of Medium Tactical Vehicles (FMTV) and the Low Signature Armored Cab (LSAC) – both of which were produced by Stewart & Stevenson, a private manufacturing company based in Houston, Texas. The FMTV was the newest generation of utility trucks designed to replace the aging M35 "Deuce-and-a-Half" and M939 5-ton trucks. LSAC, according to the manufacturer, gave "ballistic and mine blast protection for the crew in a purpose-built cab that can be interchanged with a standard FMTV cab in eight hours. The LSAC cab can provide the crew protection from assault rifle rounds, land mines, and artillery fragments and still retain C-130 transportability…and can be installed on any FMTV vehicle in the fleet."

Stewart & Stevenson was acquired by Armor Holdings in 2005, which in turn was bought by BAE in 2007. Recognizing the FMTV's and LSAC's adaptability to the MRAP program, BAE added composite armor to create the first Caiman prototype. The Caiman completed its first trial run at Aberdeen Proving Grounds in July 2007 and the first deliveries were made to the US Army later that month. Originally, the Caiman was developed as a 6x6 vehicle exclusively for the MRAP Category II program. However, most of the vehicles procured from BAE were equipped "with Category I seating configurations and are often listed as Category I MRAPs in official US Army documents."

A Caiman belonging to Delta Company, 1-186th Infantry Battalion, 41st Brigade Combat Team, prepares to leave on another patrol from Camp Adder, Iraq, on October 31, 2007. Visible in the background is an M1117 Armored Security Vehicle, which, although not selected for the MRAP program, still served in a variety of MRAP-related roles during the Iraq War. (US Army)

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A Caiman at a Forward Operating Base in Iraq. This Caiman is equipped with an electronic IED detection system attached to the front grille. This vehicle is also equipped with an Objective Gunner's Protection Kit (OGPK). The OGPK contains a 360° armored shield and ballistic glass, which allows the gunner to engage targets without displaying a prominent silhouette. Many units in Iraq and Afghanistan added the camouflage netting to the OGPK to further disrupt the gunner's silhouette from the enemy. (US Army)

A Caiman on patrol in Samarra, Iraq, January 2008. This Caiman belongs to a combat patrol of the 2-327th Infantry Battalion, 101st Airborne Division. The Caiman is powered by a Caterpillar C7 engine and can negotiate slopes with a grade of up to 60 percent. (US Army)

From December 2007 until March 2008, BAE received orders in excess of $1.5 billion to deliver Caimans to the US Army and Marine Corps. At the end of 2007, for instance, Marine Corps Systems Command placed an order for 668 Caiman vehicles, which preceded another order for 1,024 vehicles the following spring. In January 2008, BAE announced that it would begin developing an upgraded version of the Caiman. Under a $5.7 million contract, the DOD reserved the right to order up to 20,500 vehicles over the ensuing fiscal year.

In October 2008, BAE unveiled the Caiman Light, a 4x4 variant. "The vehicle offered comparable protection to the larger 6x6 vehicle, but at 18 tons, was two-thirds the weight of its predecessor. The 4x4 vehicle maintained 85 percent commonality in parts with the 6x6 vehicle, had the same electronic controls, and could be fitted with all-wheel steering, providing a turning radius of less 20 feet."

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CAIMAN 4X4 AND COUGAR 4X4

The Caiman series MRAP is based on the Family of Medium Tactical Vehicles (FMTV) and the Low Signature Armored Cab (LSAC). The 4x4 variant (top) features a four-wheel steering option and has a maximum speed of 65.2mph (104.93km/h). The Caiman 4x4 is powered by a Caterpillar C7 turbo-charged diesel engine coupled to a 7-speed automatic transmission with full-time all-wheel drive. The 4x4 chassis is based on the M1078 cargo truck of the FMTV series. The Cougar 4x4 (bottom) pre-dates the MRAP program by at least three years. The Marine Corps acquired the Cougar in 2004 as a combat engineer vehicle. The Cougar 4x4 can withstand a blast from up to 28lbs (13kg) of TNT to either its front or rear axle. Like its counterparts, the Cougar is scalable, meaning it can take on additional armor or downgrade for humanitarian missions. The 4x4 is also powered by the Caterpillar C7 engine and has an operational range of 419 miles (675km). Variants of the 4x4 include the Hardened Engineer Vehicle (the first variant procured by the US Marines) and the Joint Explosive Ordnance Rapid Response Vehicle.

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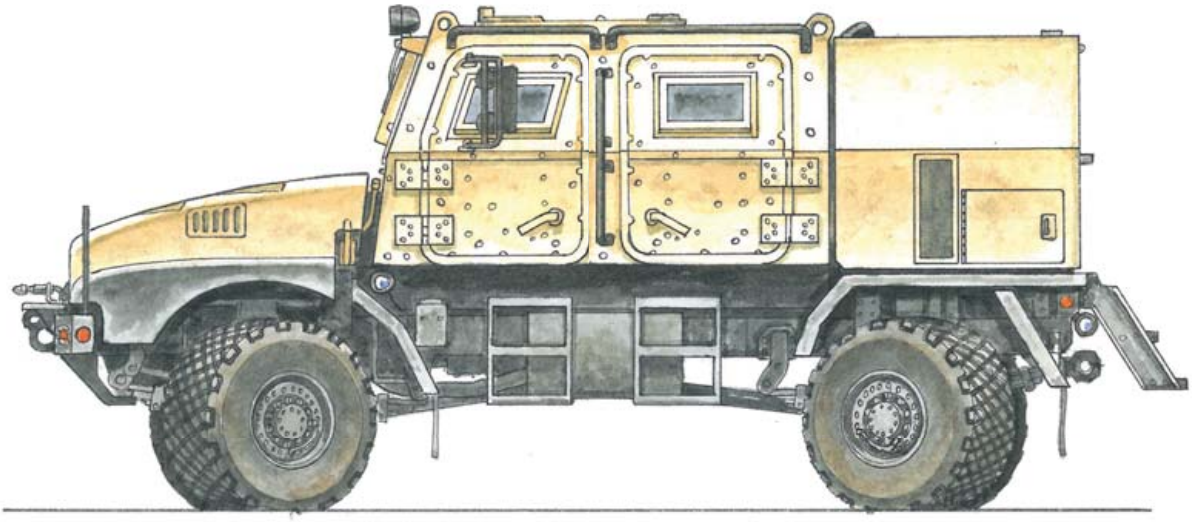

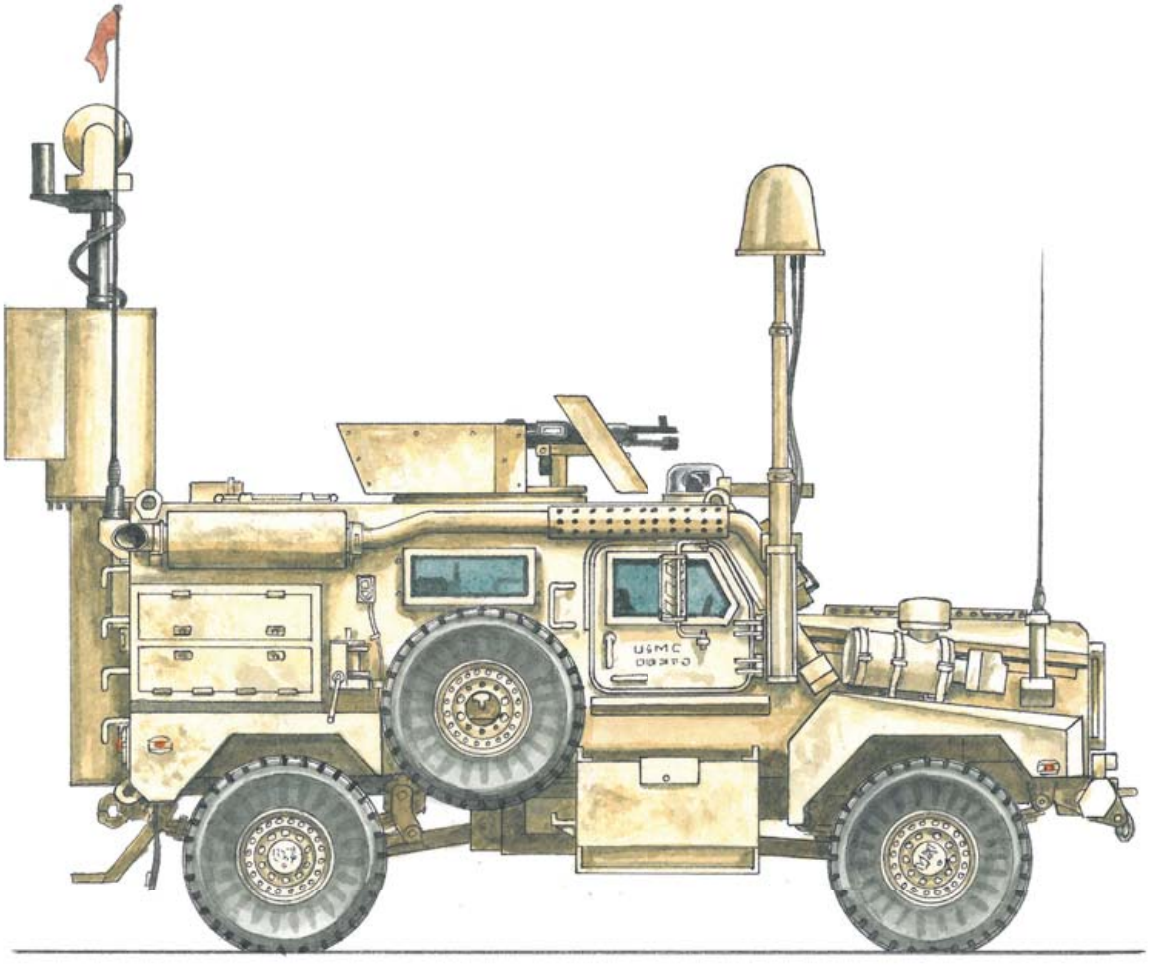

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A Caiman belonging to the 399th Psychological Operations Company negotiates the Driver's Familiarization Course at Contingency Operating Base Speicher, Tikrit, Iraq – July 1, 2010. (US Army)

Throughout its production life, the Caiman was manufactured at the BAE facilities in Fairfield, Ohio, and Sealy, Texas (the former Stewart & Stevenson plant); the V-shaped hulls would be forged in Ohio and sent to Texas for their final assembly. Production of the Caiman ended on November 20, 2008 – concurrently with BAE's moratorium on the RG-33 vehicles.

Although production ended in 2008, BAE has prolonged the life of the Caiman through various upgrades and strategic maintenance programs. Since the Caiman shares a remarkable commonality with the Army's line of FTMVs, BAE has the flexibility to address both vehicles wherever their maintenance teams are stationed. In June 2009, Marine Corps Systems Command awarded BAE another contract ($19 million) to upgrade its existing fleet of 1,800 Caimans. At the outset of the M-ATV competition, BAE developed prototypes that were based largely on the Caiman 4x4. Although BAE's entry lost to the Oshkosh design, BAE did receive a contract in September 2010 to convert 1,700 Caimans into the Caiman Multi-Terrain Vehicle (MTV). The MTV was a model introduced by Caiman earlier that year, said to provide "an effective combination of interior capacity, tactical mobility, operator comfort, and survivability." Unlike BAE's earlier M-ATV design, the MTV was based on the 6x6 chassis. Its upgrades included an independent suspension system designed by Arvin Meritor, an improved armored cab, a stronger chassis, and better seating.

Specifications	Caiman 4x4	Caiman 6x6
Operators	USA	
Length	256.6in.	309in.
Width	101.9in.	121in.
Height	121.6in.	143in.
Minimum Ground Clearance	14.4in.	14.4in.
Maximum Speed	65.2mph	64.4mph
Standard Weight	27,899lbs	50,620lbs

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BAE/GENERAL DYNAMICS RG-31

Although not as well-known as the Caiman, the RG-31 "Nyala" and the RG-33 have proven to be just as effective as their celebrated stablemate. Based on the Mamba APC, the RG-31 was manufactured by Land Systems OMC, the South African division of BAE. The RG-31 carries many of the features typically found on South African mine-resistant vehicles. This includes a high suspension and a monocoque hull designed to withstand simultaneous blasts from two TM-57 landmines (the enemy's weapon of choice during the Border War and the Rhodesian Bush War).

The RG-31 has several variants, each designated by an "Mk" suffix. The RG-31 Mk 5 features four-wheel drive and (theoretically) is suitable for both on-road and off-road maneuvers. Like most MRAPs, the RG-31 can be modified for a variety of roles. "The modular interior layout could be configured for armored personnel carrier, command and control, ambulance, scout vehicle, or other applications." The engine, transmission, and fuel cell were situated inside the armored hull for maximum protection. Shear-off fenders were provided for water and equipment storage. For self-protection, the vehicle was equipped with 11 gun ports for personal weapons and a single top-turret hole. On some vehicles a remote weapon station was fitted to the top of the vehicle, further improving the crew's ability to return fire while being protected. For route clearance operations, spare tires were normally removed and additional armor added to protect air tanks and fuel lines.

The RG-31 Mk 5E featured a few upgrades from the Mk 5, but the most notable difference was its longer length. The RG-31A3 (also known as the RG-31 Mk 5 Enhanced Mobility) featured a similar hull length to the standard RG-31 Mk 5, but was fitted with a more powerful 300 horsepower engine.

Prior to its debut in the Unites States Army, the RG-31 had been used extensively by NATO and UN Forces in various peacekeeping operations throughout the late 1990s and early 2000s. With a proven record of reliability,

An RG-31 prepares to move through a traffic control point in Iraq, 2006. The RG-31, developed by BAE's Land Systems OMC, was based on the highly successful Mamba Armored Personnel Carrier. The Mamba was among the many mine-resistant vehicles pioneered by the South African Army. (US Army)

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A US Marine Corps RG-31 rests on two tires after driving over an IED near Camp Taqqadum, Iraq, on January 7, 2006. Because of the V-shaped hull and heavy armor, all five crewmen survived the blast. One emerged unscathed while the remaining four had minor injuries. (US Marine Corps)

security, and effectiveness in route-clearing operations, DOD acquired nine RG-31s in 2003–04. During its inaugural year in Afghanistan, it became clear that this new mine-resistant vehicle was worth the cost. For in October 2004, two combat engineers assigned to Bravo Company, 367th Engineer Battalion – part of Joint Task Force 76 headquartered at Bagram Air Field – offered the following testimony:

> "While on a vehicle patrol in southeastern Afghanistan, our vehicle suffered a possible mine strike or Improvised Explosive Device (IED) attack. All 5 passengers of the vehicle were able to exit the RG-31 and run to the next vehicle in the convoy, where we were treated for minor injuries and continued to carry on with the mission. The driver, the machine gunner, and myself were taken by helicopter to the closest medical station and kept overnight for observation.
>
> After going through an ordeal like this, we feel compelled to thank the company responsible for the RG-31. We also feel that we could provide some good feedback to you in regards to what, if any, changes or additions could be made to the vehicle. We hope that the US Army takes into consideration how valuable the RG-31 is compared to an 'up-armored' Humvee, and is in the process of buying more of these vehicles. We had 2 RG-31s in Afghanistan, now we have one. The threat of mines and IEDs is still prevalent. We are ready to go back out and do our job of finding these threats; we would just feel better equipped if we had more RG-31s. We urge your company to do whatever it takes to sell or market this and all your other protective vehicles to the US Army. If needed, we can provide written testimony in regard to the RG-31."

After the RG-31's delivery and initial feedback, BAE Systems partnered with General Dynamics Land Systems to supply additional units of the vehicle to the US military. Under this agreement, General Dynamics "would provide the program management and logistics … while BAE Land Systems OMC of South Africa would manufacture the vehicles." On February 16, 2005, the US Army Program Manager for Close Combat Systems awarded the BAE-General Dynamics venture a $78 million contract (including $3 million in spare parts) to produce 148 unit RG-31s by 2006. Almost simultaneously,

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RG-31 AND RG-33

The RG-31 and RG-33 are both of South African origin – manufactured by Land Systems OMC. Like other vehicles in the MRAP family, the RG-31 and RG-33 feature a monocoque V-shaped hull and high suspension. Based on the popular South African Mamba APC, the RG-31 can accommodate a crew of 10 and has become the vehicle of choice for several UN peacekeeping missions. Pictured opposite is the RG-31 Mk3 (top), and the RG-31 Mk5 (centre). The RG-33 (bottom) uses a German Unimog chassis and was used extensively as a patrol vehicle on the urban battlefronts of Iraq.

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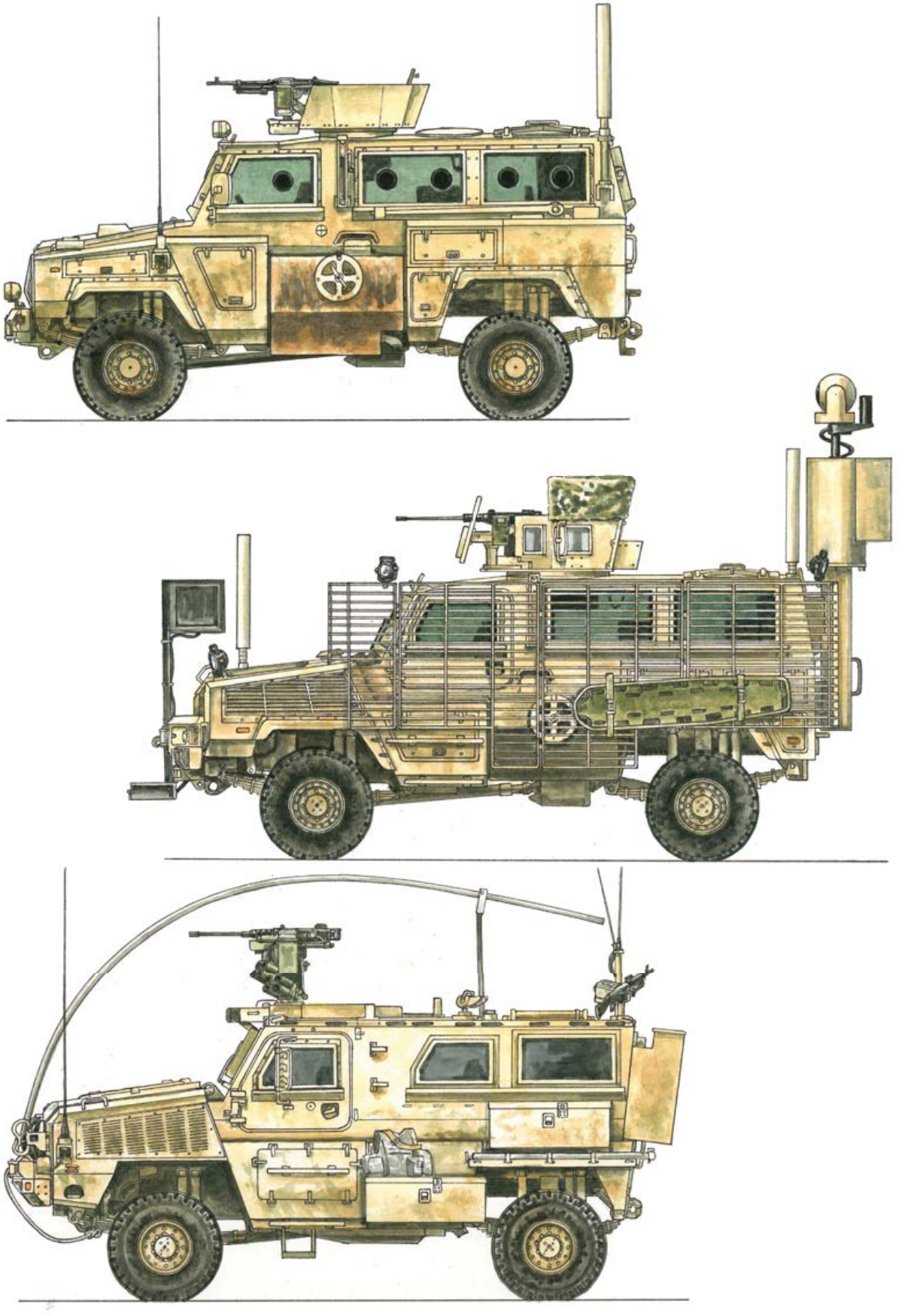

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This RG-31 rests in a crater after being torn literally in half by an IED explosion. The crew members survived the blast, but with serious injuries to all. This photograph shows that, although the MRAP variants provided much better protection over the up-armored Humvee, they were not completely immune to destruction. (US Army)

the Canadian government solicited a $60.3 million contract for 50 RG-31s to accommodate the growing number of Canadian troops deploying with NATO forces to Afghanistan. The Canadians' one stipulation, however, was that it be equipped with the Kongsberg Protector M151 Remote Weapon Station, which would allow the vehicle's gunner to fire the main armament from inside the vehicle. M151 came equipped with day/night vision capabilities and was later retrofitted onto most American MRAPs.

After the MRAP program was finally sanctioned by Congress, 2007 became the busiest year for the RG-31. That spring, General Dynamics won an $11 million contract from Marine Corps Systems Command and a $76.5 million contract from the US Army Tank and Automotive Command for delivery of selected variants of the RG-31. The following summer, the US Army solicited 44 Mk 5 variants of the RG-31 and more L-Rod slat armor kits to be retrofitted to the existing fleet. Contracts continued to flow throughout 2007 and, by year's end, the company had unveiled yet another version of the Nyala, the RG-31 Mk 6. This variant featured a longer, wider, hull and a more powerful engine.

Specifications – RG-31	
Operators	USA, UN, Canada, Colombia, Spain, South Africa, Mali, Nigeria, Indonesia, Rwanda, Swaziland, United Arab Emirates
Chassis Configuration	4x4
Length	251in.
Width	97.2in.
Height	103.5in.
Minimum Ground Clearance	13.6in.
Maximum Speed	62mph
Standard Weight	37,485lbs

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BAE RG-33 AND RG-33L

Capitalizing on the success of their RG-31 model, BAE's South African subsidiary began work on the RG-33. Developed as a close counterpart to the RG-31, BAE offered two variants of the RG-33: the Category I base model 4x4 and a Category II 6x6 variant known as the RG-33L. The 6x6 chassis could take on any number of battlefield roles, including "Infantry Carrier, Ambulance, Command and Control, Convoy Escort, [and] Explosive Ordnance Disposal." Both variants featured the monocoque V-shaped hull and offered a more spacious cabin than previous MRAP models. By itself, the RG-33 models could withstand both 5.56 and 7.62mm gunfire and almost any intensity of mine blasts. Also, as with many MRAP variants, the RG-33 could be retrofitted with additional armor. The vehicle was constructed on a Unimog chassis and featured "on-board exportable power" for the normal variety of mission equipment.

To meet the protective requirements against the EFP, BAE also developed the RG-33 Plus and the RG-33L Plus. Under the ambulance configuration, the RG-33L was known as the Heavy Armored Ground Ambulance (HAGA). The HAGA had a unique design feature that allowed the on-board medics to care for up to three critical casualties in "reconfigurable litter stations." When the litter stations were folded and not in use, the HAGA could accommodate up to six ambulatory (i.e. "walking wounded") patients. The HAGA also had additional storage space for medical supplies. A variant of the Category I 4x4, known as the RG-33 USSOCOM, was designed to the specifications of the US Special Operations Command. As such, it came equipped with "remote weapon station, swing arm mounts, internal seating for eight, integrated unique SOCOM equipment … and a rear door assist."

The first contracts were negotiated in January 2007, when the Marine Corps placed an order for two 4x4 variants and two 6x6 variants. The first contingent for series production began the following month, on

A convoy of RG-33s assigned to the US Combined Joint Special Operations Task Force – Arabian Peninsula (JSOTF-AP) makes its way through the streets of Baghdad in June 2008. The JSOTF-AP drivers assigned to the RG-33 had to undergo over 40 hours of training to certify their handling of the vehicle. (US Army)

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A Category I RG-33 MRAP. The Category I variant stands atop a 4x4 chassis and is powered by a Cummins 400 I6 Diesel engine. The vehicle has seating for a crew of eight, including the driver. (Carl Schulze)

February 14, 2007, when BAE announced that it had negotiated a new contract for $55.4 million to deliver 15 Category I vehicles and 75 Category II vehicles to the Marines. The following June, BAE filled another order for 409 vehicles (154 USSOCOM 4x4 variants, 239 standard 6x6 variants, and 16 HAGA models) to be delivered by year's end. Contracts and deliveries continued over the next year and ahalf until production ended on November 20, 2008. Although 2008 marked the end of production, BAE still provides technical support and upgrades to the vehicle. To date, there have been 1,735 RG-33s fielded to the US Army and Marine Corps.

Specifications	RG-33 (4x4)	RG-33L (6x6)
Operators	USA	
Length	265.2in.	336in.
Width	96in.	96in.
Height	114in.	114in.
Minimum Ground Clearance	14in.	14in.
Maximum Speed	68mph	67mph
Standard Weight	37,999lbs	57,999lbs

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CAIMAN 6X6 AND RG-33L

The Category II versions of their respective 4x4 counterparts, the Caiman 6x6 (top) and RG-33L (bottom) have performed a variety of battlefield roles in the War on Terror. The Caiman 6x6 stands on the same chassis as the M1084 Medium Tactical Truck. As of 2011, more than 40,000 Category II Caimans have been fielded. The RG-33L is perhaps the most versatile of the Category II MRAPs. Its most common variants include the Heavy Armored Ground Ambulance (HAGA), an explosive ordnance disposal vehicle equipped with a fully articulated robotic arm, a Special Operations Command variant, and a command and control vehicle that can serve as a company-level mobile command post. The RG-33L has several features to enhance its survivability, including scalable armor, TRAPP transparent armor, and run-flat tires. To accomplish its multiple roles, the RG-33 can accommodate a variety of battlefield equipment, including a 6-kilowatt auxiliary power unit, a 120/240 AC import/export power system, a secondary battery suite, a taillight camera, and an adaptable CROWS remote weapon system.

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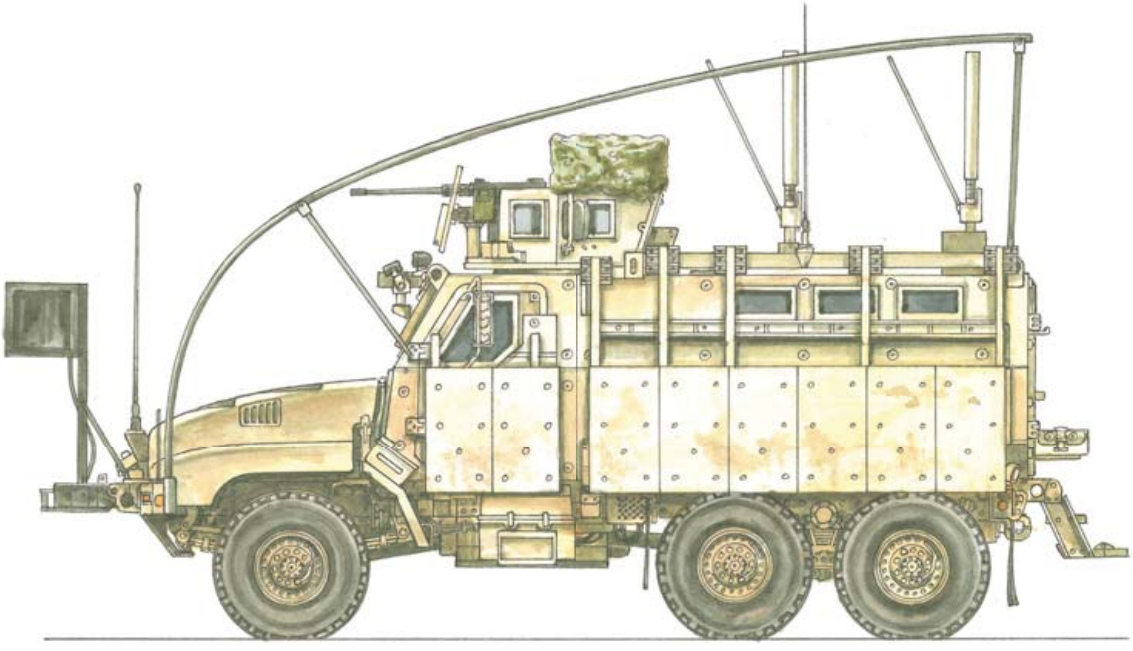

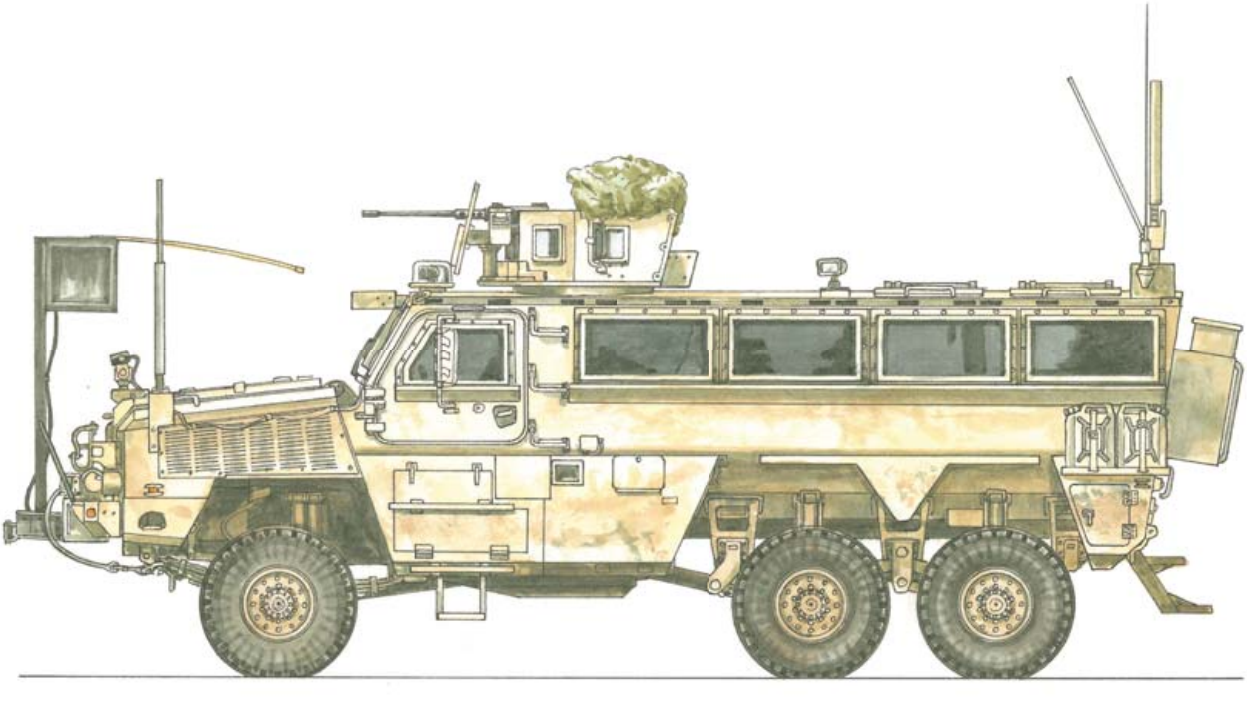

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FORCE PROTECTION COUGAR 4X4 AND COUGAR 6X6

The Cougar was developed by Force Protection Inc as a counterpart to the company's Buffalo MRV. Like the Buffalo, the Cougar pre-dated the MRAP program and was based largely on the existing fleet of South African mine-resistant vehicles. The story of the Cougar began with the defense company Technical Solutions Group Inc. In the late 1990s and early 2000s, Technical Solutions was working on a mine-resistant vehicle based on the Lion 4x4, a vehicle developed by Denel-Mechem for the South African Army. Technical Solutions was acquired by Sonic Jet Performance Inc – a company that specialized in the production of high-performance speedboats – in 2002. However, as the market for speedboats plummeted, Sonic Jet shifted its focus exclusively to the production of mine-resistant vehicles. The resultant Technical Solutions/Sonic Jet venture then renamed itself Force Protection Inc. Picking up where Technical Solutions left off, Force Protection took the concepts for the Lion-based MRAP and developed the Cougar prototype. The Cougar borrowed several elements from the 4x4 Lion variant and was given an upgraded protection package.

The Cougar series of vehicles consists of a Category I 4x4 and a Category II 6x6 variant. Both configurations were developed in 2003 and 2004, with the first model unveiled in April 2004. Optimized for the urban and asymmetric battlefronts, the Cougar offered what was then unparalleled protection for a wheeled tactical vehicle. The armor package boasted an improved ballistic performance and the monocoque frame performed very well under the intense explosive testing at Aberdeen Proving Grounds. Per its technical specs, it could withstand a direct hit from a 30lb blast of TNT under the both axles and a 15lb blast underneath the vehicle's center. The vehicle, like many of its MRAP counterparts, was scalable (i.e. it could be upgraded with add-on armor or even have its armaments removed for humanitarian missions). When configured for combat operations, the Cougar could accommodate any caliber of mounted crew-served weaponry, including the M2 Browning Machine Gun, the Mk 19 Grenade Launcher and the M240 General Purpose Machine Gun. It could also accommodate the Objective Gunner Protection

A Cougar MRAP undergoes a land mine blast test at Aberdeen Proving Ground, Maryland. During the initial MRAP evaluations, the various prototypes were put under a series of ballistic and maneuverability tests. By the time the MRAP competition began, however, the Cougar had been in active service with the US Military since 2004. Like the RG-31 and Buffalo MRV, the Cougar pre-dated the MRAP program. (US Department of Defense)

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Kit (OGPK) and CROWS remote weapon operating system. The OGPK featured full wrap-around protection for the gunner, while allowing him a 360° view of the battlefield from behind the shield of enhanced ballistic glass. Perhaps the most important protective features on the vehicle, however, were its reinforced V-shaped hull and its chemical, nuclear, biological, and radiological over-pressure and filtering system.

Cougar 6x6 variants. Personnel from the Naval Mobile Construction Battalion 3 (colloquially known as "Seabees") stand atop their Category II Cougars during an exercise called Operation *Bearing Duel* conducted at Fort Hunter Liggett near Monterey, California, 2007. (US Army)

Both the Category I and Category II models have been modified into different variants. Among the first to be marketed to American ground forces was the Hardened Engineer Vehicle, or Cougar HE. The Cougar HE was designed to meet the operational requirements of sapper and other combat engineer units. Another version of the Cougar was manufactured for the Iraqi Army. It featured the same protective components as its American counterpart and was labeled the Iraqi Light Armored Vehicle. A lesser-known (but no less important) version of Cougar was the ISS, featuring a heavy-duty shock and suspension system to allow for cross-country mobility. Modified versions of the Cougar were also sent to the British Army, where the Cougar 4x4 was renamed the Ridgeback Protected Patrol Vehicle, and the 6x6 was rebranded as the Mastiff Protected Patrol Vehicle and the Wolfhound Heavy Tactical Support Vehicle. The Category II Cougar was widely available as a Joint EOD Rapid Response Vehicle (JERRV).

The first contingent of Cougar HE vehicles were given to the US Marine Corps in April 2004. Under the order placed by Marine Corps Systems Command, 28 Cougar HE 4x4 vehicles were purchased at the collective cost of $11.3 million. The first deliveries were made in October 2004 and sent to 31st Marine Expeditionary Unit. After seven months of proven combat performance, the Marine Corps placed more orders for the Cougar in May 2005. This time, Marine Corps System Command negotiated a new contract for 122 Cougar 6x6 vehicles of the JERRV configuration. In 2006, nearly 280 JERRVs earmarked for the US Army and Marine Corps were purchased at a combined cost of over $190 million.

A Cougar 6x6 rests on its front axle after being immobilized by a massive 300–500lb IED. Although the blast rendered the vehicle inoperable, all five crewmen emerged from the wreckage unscathed. They returned to duty the following day. (US Army)

Under the official MRAP program, Cougar divided its existing fleet into the predetermined Categories I and II. The first round of Cougar platforms procured under the MRAP program were earmarked on January 26, 2007, under DOD contract M67854-07-D-5031.

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A Cougar vehicle assigned to the 1st Explosive Ordnance Disposal Company, II Marine Expeditionary Force. The vehicle was on display for civilians attending a conference at Al-Taqqadum Air Force Base, Al Anbar, Iraq – February 25, 2007. (US Marine Corps)

This Cougar 4x4 was hit by an IED while on patrol. The blast from the IED sheared off its right front road wheel but the crew was able to drive it back to a safe area on three wheels. All five crew members survived and sustained only mild concussions. (US Marine Corps)

Under this contract, only two of each base model Cougar were ordered: two 4x4s and two 6x6s. After nearly a two-week long ballistics test, the Army ordered 65 Category I Cougars and 60 Category II Cougars at a combined price of $67.4 million. The largest number of orders on a single contract came on April 23, 2007, when 300 Category I 4x4s and 700 Category II 6x6s were purchased by DOD. Additional orders through 2009 added a total of 1,530 Category I vehicles and 1,355 Category II vehicles at a combined total of $1.6 billion. After the first year of production under the MRAP contract, however, Force Protection discovered that it did not have the facilities to keep up with demand. The company therefore partnered with General Dynamics Land Systems to produce the vehicle concurrently at their facilities in Detroit, Michigan, from October 2007 onward.

Beginning in 2008, the Cougar vehicles were updated with an add-on protection package to counter the ever-present nuisance of the EFP variety of IEDs. The add-on kits were the last major upgrade to the Cougar until the introduction of the independent suspension in 2009.

Specifications	Cougar 4x4	Cougar 6x6
Operators	USA, UK, Canada, Croatia, Hungary, Iraq, Italy, Poland, Denmark	
Length	232.92in.	278.74in.
Width	108in.	107.8in.
Height	104.04in.	103.9in.
Minimum Ground Clearance	15in.	15in.
Maximum Speed	65mph	65mph
Standard Weight	32,000lbs	38,000lbs

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COUGAR 6X6

A Cougar 6x6 returns fire during a battle with local insurgents in Iraq. The Cougar 6x6 is powered by a Caterpillar C-7 Diesel I6 engine and can accommodate a crew of up to 10 personnel.

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FORCE PROTECTION BUFFALO MINE REMOVAL VEHICLE (CATEGORY III MRAP)

Force Protection Inc's Buffalo Mine Removal Vehicle (MRV) is a 23-ton platform and the only vehicle produced under the Category III MRAP. Like its Category II cousins, the Buffalo MRV has found a multi-mission role in the War on Terror.

Procurement of the Buffalo MRV pre-dates the MRAP Program. As early as 2000, the US Army solicited bids for a vehicle under its Ground Standoff Minefield Detection System (GSTAMIDS) program. GSTAMIDS grew out of the shift in military doctrine that followed the defense drawdown of the 1990s. As the US military began participating in low-intensity conflicts, peacekeeping tours, and other contingency operations (e.g. Somalia and the Balkans), the need arose for a vehicle that could detect mines for route clearance and convoy operations.

The initial GSTAMIDS entries included the Meerkat MDV and Husky T/MDV, both of which had been developed in South Africa. When Force Protection Inc (then known as Technical Solutions Group Inc) submitted their bid for the program, they gave the Army a design based on the Denel-Mechem Lion II – a mine-protected personnel carrier that had seen extensive service in the South African Army during the latter years of apartheid. Code-named "Buffalo," the Force Protection design featured the archetypal V-shaped hull, six wheels, and a large, fully articulated robotic arm that could remove roadside ordnance at minimal risk to the crew. With the assistance of 200x zoom camera, the crew could evaluate roadside objects via a television interface from inside the cabin. The vehicle could comfortably seat six, "with the driver and operator at the front and the four remaining soldiers behind them designated for observation." Enclosed within the vehicle's cabin, the crew stood nearly 12ft from the ground and could operate a set of high-wattage searchlights during nighttime operations.

The US Army procured a set of ten Buffalo MRVs in September 2002, all of which were delivered in 2003. Later that year, as the US occupation of Iraq devolved into a counterinsurgency, the Pentagon placed orders for another 77 MRVs. Throughout 2004, Force Protection won more than $20 million in contracts to produce another batch of Buffalos and deliver into theater by

A Buffalo Mine Removal Vehicle (MRV) belonging to the Army's 759th Explosive Ordnance Disposal Company conducts a mine-clearing exercise at The National Training Center in Fort Irwin, California. The Buffalo MRV was initially procured under the Army's Ground Standoff Minefield Detection System (GSTAMIDS) in 2000. The Buffalo pre-dated both the MRAP program and the War on Terror. (US Department of Defense)

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summer 2005. Under this arrangement, the Buffalo deployed with the 108th Engineer Battalion in the spring of 2005. Although the battalion received classroom courses on how to use the Buffalo, most of their instruction came from on-the-job training, "actually conducting route clearance [missions] in the area of operation." During its initial forays into Iraq, the Buffalo did a stellar job of detecting and removing IEDs before they could detonate on American convoys.

This Buffalo MRV, part of the US Army's 467th Engineer Battalion, extends its robotic arm near Baqubah, Iraq, 2005. The Buffalo has been the only MRAP procured under Category III. (Carl Schulze)

By 2006, the Marine Corps Systems Command had jumped on board with negotiations for the delivery of at least 82 vehicles. When General D. J. Hejlik issued his appeal for the MRAP program, Force Protection Inc delivered the Buffalo on the coattails of the already-popular Cougar vehicle. The Buffalo had already been serving in Iraq and Afghanistan by the time the MRAP program went under way, but the newfound demand for a mine-resistant vehicle created a significant windfall for Force Protection Inc. Under its new $3.8 million contract, Force Protection delivered four Buffalos to Marine Corps Systems Command. This represented the first contract issued to the Marines for a Buffalo vehicle. Previously, the Buffalo had been delivered exclusively to the Army.

Although Force Protection came out a winner in the MRAP competition, its dealings with the Army and Marine Corps were occasionally beset by bureaucratic friction. After nearly three years of producing the Cougar and Buffalo, the DOD Inspector General's office issued a report stating that the Army and Marine Corps had violated contractual etiquette by "continuing to award contracts to Force Protection Inc." According to the Inspector General's report, both branches had relied on Force Protection Inc even though the company "did not perform as a responsible contractor and repeatedly failed to meet contractual delivery schedules for getting vehicles to the theater." Additionally, the Army and Marine Corps' business practices with Force Protection "were said to have possibly limited the Government's ability to ensure it paid fair and reasonable prices." Business practices and theoretical contract etiquette aside, the Buffalo performed remarkably well in the War on Terror. With the success of the vehicle, Army and Marine Corps representatives continued placing orders until 2008 and, by the end of that year, the US military had over 200 MRVs in service.

A Buffalo MRV in French service is displayed with desert "tiger stripe" camouflage pattern. The Buffalo comes equipped with a fully articulated arm that can grab suspected land mines or other dangerous objects at a distance of nearly 7m. (Author's Collection)

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This Buffalo MRV, equipped with the anti-RPG "slat" armor, survived an IED attack that took the two front wheels off its axle. The crew survived. (US Army)

Specifications – Buffalo MRV	
Operators	USA, UK, Canada, France, Italy
Chassis Configuration	4x4
Length	324in.
Width	102in.
Height	156in.
Minimum Ground Clearance	15in.
Maximum Speed	65mph
Standard Weight	45,320lbs

BEYOND THE MRAP: THE JOINT LIGHT TACTICAL VEHICLE (JLTV)

According to several DOD officials, the MRAP was never intended to be a permanent addition to the US force structure. Like other weapon systems throughout history, the MRAP was created to fulfill a specific need until newer technology could create something better, lighter, and less expensive. The forthcoming Joint Light Tactical Vehicle (JLTV) is the answer to the military's current technology gap – seeking to combine the protection of the MRAP with the agility of the current Humvee. Beginning in 2015, the Army plans to replace its fleet of Humvees with the JLTV. Simultaneously, the Marine Corps plans to order 5,500 units.

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BUFFALO MRV

The Buffalo Mine Removal Vehicle (pictured here with additional "cage" armor to deflect enemy RPG rounds) pre-dates the both the MRAP program and the War on Terror. It grew out of the US Ground Standoff Minefield Detection System (GSTAMIDS) program in 1999–2000, which addressed the need for a vehicle capable of detecting mines for route clearance and convoy operations in low-intensity conflicts and peacekeeping tours such as Somalia and the Balkans.

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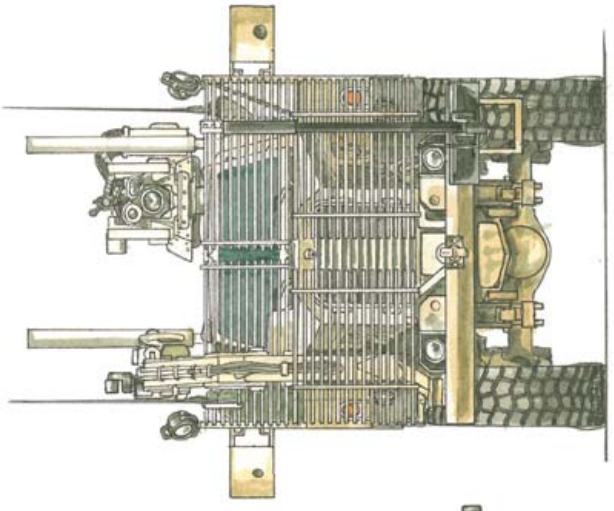

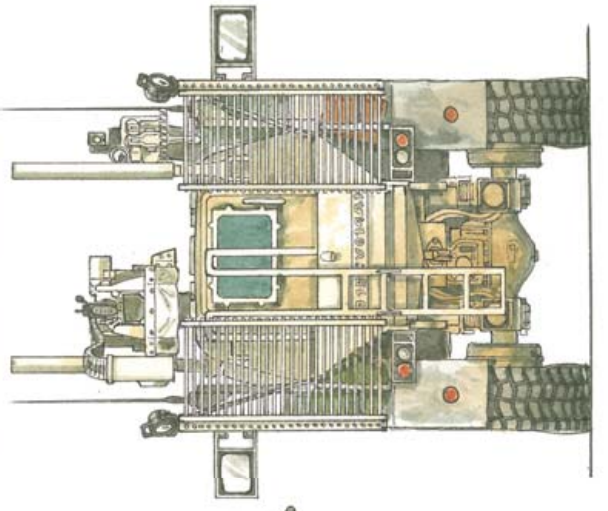

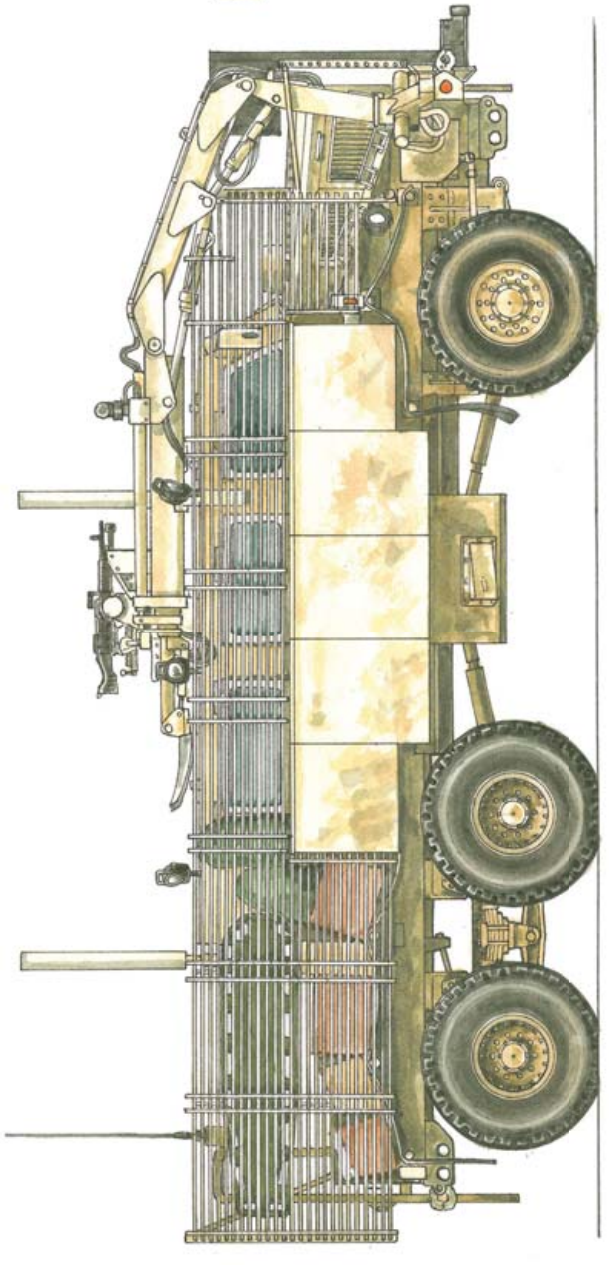

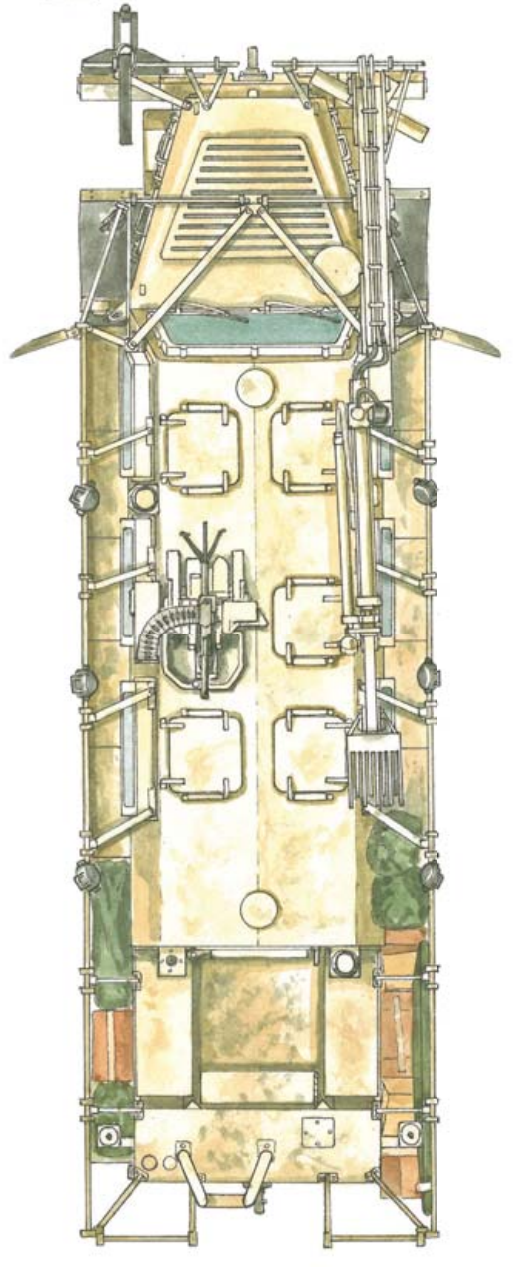

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The Valanx, designed by the veteran MRAP manufacturer BAE Systems, is one contender for the US Military's Joint Light Tactical Vehicle (JLTV) Program. (BAE Systems)

The JLTV is expected to be transportable by helicopter and provide 30kW of external power. "Six variants with companion trailers will make up the JLTV family, which will include a four-seat, close-combat weapons carrier, a two-seat utility carrier and shelter, a four-seat general purpose vehicle, a heavy guns carrier," and a mobile command vehicle. As of this writing, four defense contractors have developed prototypes for the JLTV program: BAE Systems, Lockheed Martin, Oshkosh Defense, and General Tactical Vehicles – a joint venture of General Dynamics Land Systems and AM General.

BAE Valanx

BAE Systems entered the competition with their design, the Valanx, a portmanteau of V-shape (referring to the hull) and phalanx (referring to Ancient Greek battle formation). Designed on a 4x4 chassis, the Valanx comes equipped with the latest in on-board "command and control" systems: GPS, long-range communication, and battlefield trackers. Like many of BAE's combat vehicles, the Valanx prototype carries a composite armor designed to absorb high-impact blasts at close range. The turret features a 360° shield for the gunner with safety-glass viewing ports.

Structurally, the Valanx seeks to achieve the delicate balance between mobility and survivability. "Clip structures forward and back take the load into the suspension system to provide greater survivability." This, in turn, allows the design team more flexibility in adjusting the ground clearance and adding supplemental armor. BAE has not yet finalized the ground clearance of the Valanx model, but the earliest prototypes had 24in.

Lockheed Martin JLTV

Lockheed's version of the JLTV features a V-shaped hull, provides the same level of blast protection as a Category I MRAP, and weighs 40 percent less than the Oshkosh M-ATV. During the initial testing and design phase, Lockheed recorded more than 160,000 road miles on their JTLV equipped with the Gunner's Protection Kit (see photo). These road tests revealed a fuel efficiency of 12 miles per gallon. While this fuel economy may seem laughable to civilian motorists, 12 miles per gallon is a 50 percent increase over a Humvee. Lockheed plans to stabilize their prototype's weight to 13,800lb, which will provide a reasonable margin for additional armor or other necessities as dictated by further field tests.

In designing their version of the JLTV, Lockheed sought to address the complaints about several MRAPs' lack of ergonomic detail. Determined to create a user-friendly cab, Lockheed dug into its aerospace past "to incorporate a substantial amount of capability into the dashboard, which frees space for the war fighter." According to Kathryn Hasse, Lockheed's director of tactical wheeled vehicles, "We're going to provide levels of force protection that the Army requires which are substantially more than JLTV was and originally intended to do, and we're going to do it in a package that is very reliable."

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Oshkosh Defense L-ATV

Capitalizing on its success with the M-ATV, Oshkosh entered the JLTV competition with their prototype, the Light Combat Tactical All-Terrain Vehicle (L-ATV). Rob Messina, Oshkosh's vice president for defense engineering, says that his company "can show reliable history, well-developed components, and performances that are in the range the customer is looking for."

Indeed, the L-ATV incorporates several "state-of-the-art" components. It features a fully electric power train and new TAK-4i computer-controlled suspension system. "Built on 10 years of operational experience in Iraq and Afghanistan, the system provides up to 20 inches of independent wheel travel." Improved shock absorbers also allow for better handling and higher speeds across rough terrain. These aggregated developments make the L-ATV over 50 percent faster than the M-ATV MRAP.

Lockheed Martin showcases three of its variants for the JLTV Program. (Lockheed Martin)

General Tactical Vehicles JLTV

Like its Lockheed counterpart, the General Dynamics-AM General JLTV does not yet have a model name. AM General, who designed and manufactured the Humvee, has incorporated many of the Humvee's features into its prototype of the JLTV. A major update, however, is the incorporation of the Stryker's double-V hull. Prototype redesigns are currently focusing on ground clearance and overall platform durability

Whichever JLTV prototype ultimately wins the contract, the vehicle will enter production in 2015 at the projected cost of $270,000 per unit. From these beginnings, over 25,000 JLTVs are expected to enter service by 2020.

THE MRAP: AN UNCERTAIN FUTURE

As of this writing, the US is rapidly drawing down its forces in Iraq and may soon begin a similar withdrawal from Afghanistan. As the US Military refocuses its training toward conventional warfare, many have wondered if the MRAP has outlived its effectiveness. The question remains what will become of the 23,000 Army and Marine Corps MRAPs once the US closes the book on Operation *Enduring Freedom*.

Although the MRAP was fielded to counter a specific threat, DOD officials have made it clear that the MRAP was only an interim solution until the JLTV could be fielded. However, the JLTV will not enter production until late 2015 and the US Army and Marine Corps will not completely replace the Humvee until 2025.

On the one hand, the US Military is nearing the end of its commitment in Afghanistan. On the other, the MRAP is a highly effective vehicle that meets IED protection requirements and fills an operational gap pending the JLTV's release. Although the "DOD expects the near future to be one of persistent conflict and irregular warfare," said Major Raymond Longabaugh of the 307th Brigade Support Battalion, it is dangerous to assume that the "requirement for

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The General Tactical Vehicles version of the JLTV. (US Army)

IED protection will go away anytime soon. However, the force protection requirements will vary from one conflict to another, and the balance of survivability and mobility are difficult to determine in advance."

Therefore, many have advocated incorporating the existing fleet of MRAPs into the current force structure. Although they require more maintenance and specialized support than the Humvee, the MRAP is capable of performing many of the same functions. In other instances, the MRAP could be a reliable complement to the Army and Marine Corps' family of light and medium tactical trucks.

In this regard, some have advocated supplementing transportation companies with MRAPs to enhance convoy security. Operations in Iraq demanded the use of convoys along the urban transit systems. During the first phase of Operation *Iraqi Freedom*, while most units experimented with homemade armor and sandbags to enhance their Humvees' protection, the 181st Transportation Battalion "started transforming cargo trucks into gun trucks" just to provide adequate security for its convoys. At one point, the 181st began using "tiger teams"; teams of multiple Humvees that would travel "ahead of and adjacent to convoys to provide route reconnaissance, rapid route clearance, and increased reactions times for convoy commanders." According to Richard Killblane, the US Army Transportation Corps historian, "nearly every unit in Kuwait and Iraq that ran convoys experimented with armor" and developed its own ad hoc methods for convoy security.

Tactical transportation units often have to rely on external assets for convoy security. However, since Army doctrine required transportation units to provide their own convoy security, supplementing them with MRAPs would give them a decided edge in a tactical environment. One notable example of RAP integration occurred in April 2009, when the 32nd Transportation Company (based at Fort Carson, Colorado) deployed to Afghanistan. Weeks prior to the deployment, the company was given 18 MRAP vehicles to supplement its regular inventory of tactical trucks. Throughout its tour in Afghanistan, the 32nd "was able to maintain higher levels of efficiency," with increased command and control, and better survival rates of personnel and cargo. Advocates of the transportation company augmentation point out the 32nd's tactical successes and contend that MRAP supplementation would allow for "better unity of command within the convoy, better proficiency in battle drills within the convoy elements," and that the Army would ultimately "enhance its ability to secure and transport supplies across the battlefield."

For the foreseeable future, however, the MRAP will likely serve as an accessory training vehicle within the Marine Corps operating forces and the Army's modular brigades. A 2010 Congressional Research Service report states that the Army plans to "create an effective mix of wheeled vehicles" by parceling its 19,000 MRAPs across the various types of modular brigades: "5,570 MRAPs in infantry brigade combat teams (BCTs), 1,700 in heavy BCTs, 165 into Stryker BCTs, 5,350 in support units, 1,000 in training sets, and 1,000 in war reserves. The remaining MRAPs can go into Army pre-positioned stocks." Under this plan, the Army intends to place MRAPs into "as many as 20 BCT sets in Kuwait; Charleston, South Carolina; and Sierra Army Depot, California. These MRAPs will remain available for future

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operations in which protection is more important than maneuverability."

The Army's 2011 Tactical Wheeled Vehicle Strategy calls for a similar approach, focusing redistribution on specialized units (i.e. combat engineers and explosive ordnance disposal) while maintaining organic sets for the modular combat brigades. These so-called "BCT sets" of MRAPs would remain in storage until the need for them arises again. Current plans estimate that 60 percent of the MRAP fleet will end up in storage or pre-positioned stocks; 30 percent will remain in the active fleet; and the remaining 10 percent will be designated for "home-based troop training."

Some of these MRAPs could also be transferred to allied nations for assistance in counterinsurgency and contingency operations. In fact, many of the MRAP variants in service with the US Military are also used by NATO forces, and former Secretary of Defense Robert M. Gates promised to "sell, loan, or donate surplus US bomb-detecting equipment, including MRAPs," to US allies. Some had expected the Afghan National Army (ANA) to receive a number of MRAPS, but the mobility restrictions for legacy MRAPs means that the US has instead decided to field Mobile Strike Force Vehicle (MSFV) for the ANA. "The MSFV family is based on the M1117 and associated variants offered by Textron Marine and Land Systems."

During its brief combat history, the Mine Resistant Ambush Protected Vehicle has played a unique role in America's wars of the 21st century. Amidst the tide of asymmetric warfare and counterinsurgency operations, the MRAP provided a much-needed solution to a creative, yet deadly, insurgent weapon – the Improvised Explosive Device. Despite its drawbacks (including high susceptibility to rollover, clumsy off-road road, etc.) the MRAP has quantitatively saved lives that otherwise would have been lost in the counterinsurgency environments of Iraq and Afghanistan.

Although the MRAP will likely be sent to the scrap yard after the JLTV fielding is complete, the vehicle has nonetheless provided the Army and Marine Corps with a protective capability suitable to the asymmetric warfare environment.

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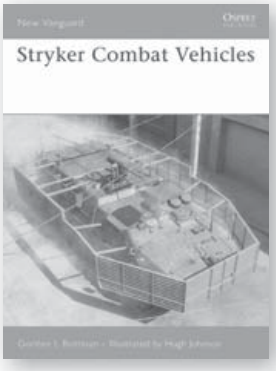

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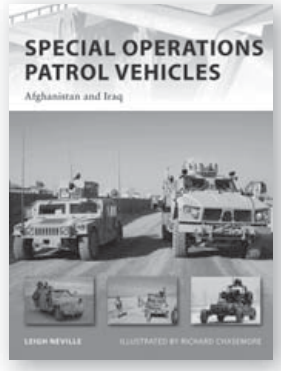

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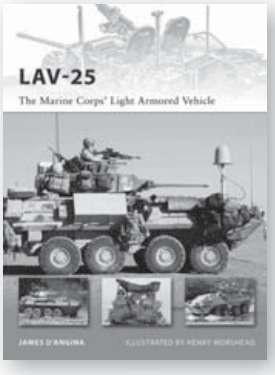

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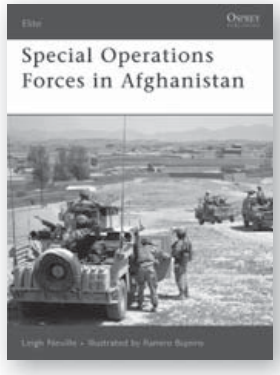

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EDITOR'S NOTE

For ease of comparison please refer to the following conversion table:

1 mile = 1.6km
1yd = 0.9m
1ft = 0.3m
1in = 2.54cm/25.4mm
1 gallon (Imperial) = 4.5 litres
1lb = 0.45kg

AUTHOR'S NOTE

The reader must bear in mind that the history of the MRAP program is both complex and non-linear. For simplicity's sake, I refer to all vehicles featured in this book as "MRAPs," even if they were in service with the US Military before the MRAP program officially began. The term MRAP has become a generic label for the various types of wheeled, mine-resistant vehicles. The reader must also bear in mind that several manufacturers have built MRAPs – either solo or in partnership with other companies. In some instances, one company would design an MRAP, while another company would take responsibility for building it. Other MRAP manufacturers were bought out or changed names at different times during their participation in the program. Again, for simplicity's sake, I have labeled each vehicle according to what company it was most commonly identified with.

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